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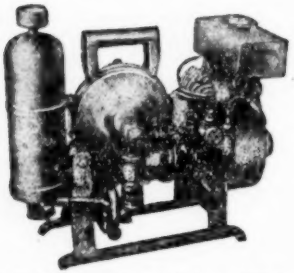

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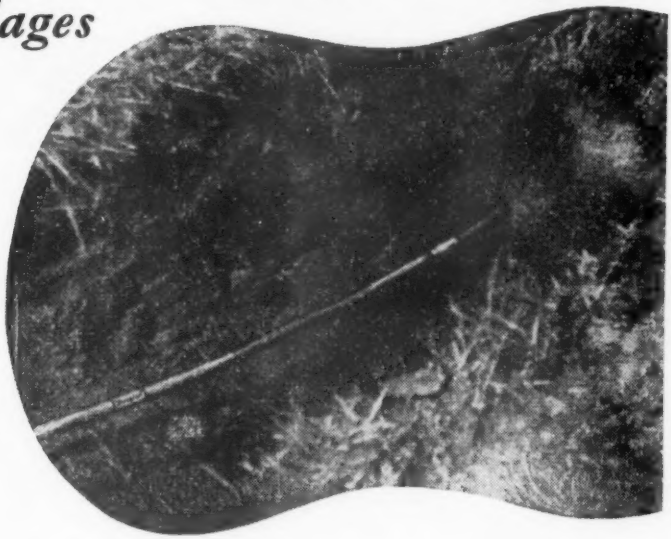

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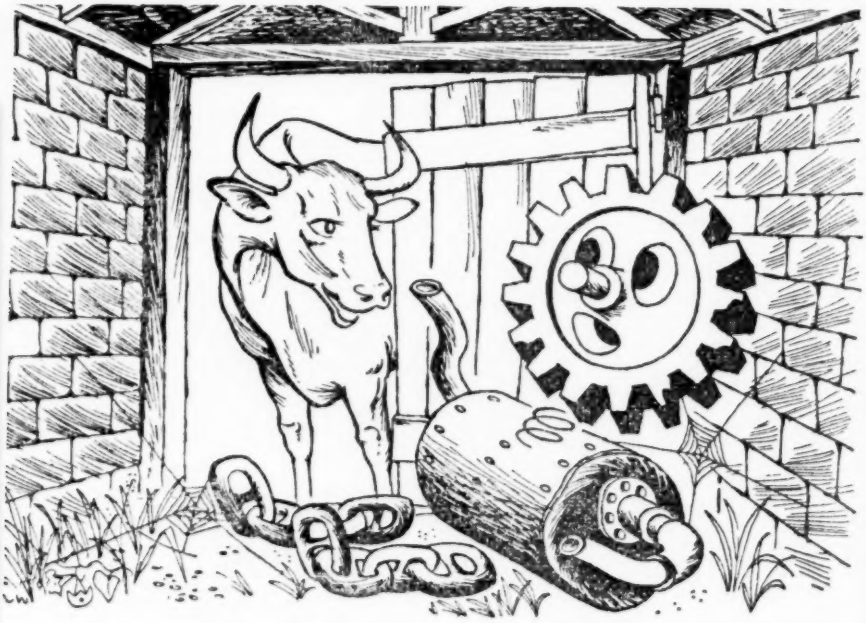

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THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Editorial Offices : St. Andrew's Place, Regent's Park, N.W.1 (*Phone* : *WELbeck* 7711)

VOL. LVIII No. 8 NOVEMBER 1951

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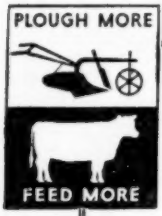

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AGRICULTURE

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

VOL. LVIII No. 8 NOVEMBER 1951

THE DIETETIC VALUE OF HERBAGE PLANTS

H. G. CHIPPINDALE, M.Sc.

National Agricultural Advisory Service, South-Eastern Province

The following very thoughtful article on the importance of the make-up of pasture herbage to the balanced diet of the grazing animal is reproduced from the Annual Journal, 1950, of the South-Eastern British Friesian Breeders' Club, with kind permission of the Secretary.

GRASS and the grazing animal have been associated over such an immense period of time that it would appear self-evident that the one is a complete food for the other, and traditional management in animal husbandry has demonstrated that this is broadly true. For some centuries, however, the animal breeder has set himself to develop either the production of meat (i.e. rapidity of growth or reproduction), or milk, or both, to such a high level that the nutritional demands of the animal have become far greater than can ever have obtained in a state of nature. Especially is this true of the milk cow where at the same time a diet has been employed in farm practice which has often had little relation to pasture herbage.

Recent research in New Zealand has shown that the individual animal has a marked idiosyncrasy in its digestive efficiency. The animal giving the highest milk yield on grass may perform relatively poorly on processed food and vice versa, so that there is nothing anomalous in pasture being an inadequate diet for the highest yielding cows. On the other hand, it is clearly imperative in present-day circumstances that grassland herbage, whether grazed or processed, should be as nearly a complete diet for the dairy cow, and still more for other stock, as can possibly be achieved.

In pasture herbage there are three main groups of plants—legumes, herbs and the grasses proper, and from this mixture of species the grazing animal must obtain a diet of considerable complexity. Carbohydrates (starch, celluloses, sugars, etc.), nitrogenous compounds (proteins, amino-acids, etc.), minerals, vitamins, and "fibre," represent the broadest classification of the animals' requirement, and to these must perhaps be added hormonic substances such as oestrogens, about which we know little.

Fibre in some quantity seems necessary in the diet of the ruminant, since without this stimulus the rumen tends to become static, and the familiar symptoms of bloat are liable to occur. It seems clear that not all types of bloat can be referred to a deficiency of fibre, but it is a matter of general observation that animals grazing succulent vegetation are prone to this trouble, and the clovers with their low fibre content appear frequently to be a causal factor. On the other hand, fibre is not commonly deficient in the

grasses proper, since it represents in their physiology the end product towards which the carbohydrate content tends to move with increasing maturity. For high-yielding cows (especially of the Channel Island breeds) any tendency for the pasture to show maturity of tissue is liable to result in a shortage of digestible carbohydrate and an excess of fibre in the diet, since, where lignification is complete, passage of tissue through the animal in an unchanged condition occurs, and such tissue can carry with it cell contents which would otherwise contribute to the nutrition of the beast. Herbs in pasture are usually lower than the grasses in fibre content, but rarely, if ever, induce bloat, although the contrary is true of cruciferous plants such as rape.

Vitamins also, considered in relation to the ruminant's requirement, appear present to excess in fresh pasture, but with dried grass the rapid fall in carotene and in vitamin E during storage has to be kept in mind.

The part played by hormones in British pasture husbandry is at present largely unknown. Oestrogens appear to reach their maximum in the grasses at the time of initiation of flower primordia (i.e., early spring), and there is evidence that they can have a direct effect on milk secretion. It is possible also that they may have a bearing on the vexed question of animal fertility, but so far this is not suggested by field experience.

The Protein Fraction During the last decade in Britain, the protein content of pasture has probably received more emphasis than any other aspect of grassland, and this is justified in so far that "grass" is by far the most convenient source of protein on the farm, and has fair claims to being the most efficient nitrogen producer of all our crops. Here clovers take prominence in the pasture complex, since not only are they themselves richer in nitrogen than any but the youngest grass, but they are able, through the fixation of atmospheric nitrogen, to feed with this element the grasses and herbs growing with them. It is possible, however, that in the study of pasture legumes, insufficient attention has been given to their correlation with sunshine and moisture, and in the wetter districts of Britain, or where a high water-table obtains (as in Holland), a dependence in the main on mineral nitrogenous fertilizers may be advisable—certainly the grasses proper are remarkably efficient converters of these into animal food. The necessity for young succulent herbage if a high nitrogen content is desired, is now generally realized by farmers, and such practices as strip grazing to obtain more uniform defoliation, and the use of gang mowers or other implements to prevent senescence of pasture, are becoming increasingly popular. It is, however, doubtful whether many farmers even yet appreciate how high the nitrogen level of young rapidly growing pasture can be. On the basis of a crude protein content of 22 per cent (and where gang mowing is practised or clover dominance obtains in the sward, figures much in excess of this are common), a cow eating some 150 lb. of fresh herbage obtains sufficient nitrogen for maintenance and 6 gallons in the case of Guernseys and Jerseys, and 8 gallons in the case of other dairy breeds. These figures are theoretical, being based on orthodox feeding standards, but even if further work should invalidate them, the margin of error for good pastures is so wide that it is clear that for cows grazing such pasture, nitrogen can rarely be the factor limiting milk production. It remains, however, distressingly evident that much British grassland is still of very low quality, and that nitrogen shortage must only too often occur in the nutrition of the animals grazing it, unless supplementary foodstuffs are given.

Although the different species of grass show some variation in the nitrogen content of their herbage, the differences are not nearly so great as those

which occur within the same species at different stages of growth, and with advancing maturity all compare unfavourably with the more succulent clovers. It is clear, however, that in farming practice such strains as S.48 timothy with its late date of flowering, and S.143 cocksfoot with its reduced production of seed, are more likely to maintain a fair nutritive quality than are strains and species having a marked propensity to seed early and abundantly. What part the proteins of herbage seeds can play in animal nutrition we do not know, but practical experience does not suggest that when present on a pasture they can be relied upon for high milk production. In general, also, pasture herbs are much less efficient as nitrogen producers than the grasses, but chicory shows an equivalent composition to that of the best grasses, and on poor hill soils such species as ribgrass compare favourably with them.

Carbohydrate Status When we come to consider the carbohydrate status of pasture it has immediately to be recognized that there is little critical data that finds general agreement among workers on animal nutrition. It is clear, however, that young, immature grass is essential if a high content of digestible carbohydrate is required, and, as with nitrogen, the stage of growth produces a wider variation in composition than does difference of species. The superiority of leaf tissue as against stem is also generally accepted both in regard to the nitrogen and digestible carbohydrate content, so that the latter should be higher in farm practice where the leafy pedigree strains of grass are grown.

Using the commonly employed formulae for starch equivalents, grass with 20 per cent crude protein would provide adequate carbohydrate for maintenance and somewhat more than 4 gallons of milk in the case of the large dairy breeds. In other words, carbohydrates on such pasture start to limit milk production much before the nitrogen content, and the excess of nitrogen has to be eliminated from the animals' digestive system. Such elimination in itself appears to increase the animals' consumption of carbohydrate, and where the nitrogen excess is extreme, ketosis (acetonaemia), and other digestive disorders, are liable to occur. A balance between nitrogen and carbohydrate is commonly regarded as obtaining in herbage showing approximately 16 per cent crude protein in the dry matter, but pasture of this composition is only adequate in theory for milk production and barely 4 gallons in the large dairy breeds. The moral would appear to be that where we want the maximum utilization by the dairy cow of first quality pastures, some supplementary feeding of foods rich in carbohydrates must occur, and grain derivatives will most often in practice be employed. Supplementary ("complementary" might be the better word) carbohydrates would appear to be particularly necessary with clover-dominant swards, since the legumes, relative to grasses, are poorer in these constituents.

Although there is little known regarding the pasture herbs, there is some reason to think that certain species might be able to play an important part in supplying carbohydrates to the grazing animal, since they are undoubtedly less fibrous than the grasses, and some herbs have a productive capacity little inferior to that of grass. Yarrow and burnet have long been in favour for sheep, but probably the most outstanding of pasture herbs is chicory, since this plant produces a great quantity of non-fibrous leaf, and its carbohydrate reserve is the readily digested inulin. It is true after the seeding year, chicory is liable to throw up coarse flowering stems, but these are not seriously troublesome under pasture conditions, especially if the variety "Whitloof" is grown. Chicory would appear to offer a valuable balance to the legumes in a sward, particularly if the observation that it has some preventive action against bloat should be confirmed.

Sward Minerals The mineral content of herbage grown on normal fertile soil has in the past been regarded as adequate to the requirement of the grazing animal, except that common salt (i.e. sodium and chlorine) may be insufficient. Where deficiencies have been found, fault and remedy have alike been dependent on soil conditions and fertilizer treatment rather than on the botanical character of the herbage as such. It is, however, established that the specific differences of herbage plants can be operative in mineral relations, and we have little knowledge of the "availability" to the animal of minerals present in herbage, bound up as this is with the ionic relations, not only of plants and soil, but within the physiology of the animal itself. So far as British grassland is concerned, the position would seem to be general that potash and calcium are usually present in the herbage much in excess of the animal's requirement, and legumes and herbs have usually a higher content of calcium than the grasses, especially if the soil is deficient in potash. Although the latter element in herbage appears always to be adequate for the animal's demands, the interaction between potash and other elements in animal metabolism is little understood, and it has always to be kept in mind that milk production tends over the years to deplete the soil in this element. Phosphate-deficient herbage has been productive of serious animal ill-health abroad, but in Britain has been confined to the poorest hill pasture on acid soil. It is, however, possible that the commonly accepted figures for the requirement of the milk cow for this element have been placed too low, and that, with some herbage, phosphates may be inadequate for high-yielding cows. Attention has been focused recently on a possible relationship between fertility in cattle and the calcium/phosphate ratio of the diet, and should further work establish this belief, the botanical composition of swards may acquire fresh significance. Legumes and herbs tend to show a higher calcium/phosphate ratio than the grasses, and all three groups increase in calcium content with maturity. Where clovers are vigorous in the sward, young growing tissue must be maintained in the grasses which accompany them if the phosphate proportion is to be at a satisfactory level, and for this purpose the leafy strains have an obvious advantage, and timothy with its late-flowering character, must be peculiarly valuable.

It has, however, perhaps become necessary to emphasize that a low calcium/phosphate ratio can be equally or more harmful to animal health, than the converse position and that such ratios can occur where the sward is exclusively grass, kept very short by grazing or mowing, on fertile soil.

Animal ill-health has followed dietetic deficiency in cobalt, copper, manganese, magnesium and iodine, but except for the first two of these, there has been no case in Britain of the herbage itself showing a deficiency in the element which the animal has found inadequate. For example, with pasture on which "sway-back" in sheep occurs, the herbage contains a normal (or higher than normal) amount of copper, although the disease is remedied by feeding copper to the breeding animal which has not apparently been able to utilize fully the copper in the grass* ; again, magnesium deficiency in cattle cannot be related to magnesium shortage in the pasture they graze. In other words, the absolute amounts of these elements, as determined by chemical analysis do not by themselves indicate their availability to the animal, but whether the different species of plants can affect the position, we do not know. The herbs are rich in minerals relative to clovers and

*Copper deficiency in pasture herbage has recently been found in Caithness, and it is very possible further cases of deficiency in the minor elements will come to light as more critical work is carried out.

grasses if the high content of the latter in silica (which is valueless to stock) is disregarded, and on poor soils, the deeper-rooting species (such as chicory and dandelion) would appear to have advantages, since they can presumably obtain their minerals from the lower soil. Even on soils of normal fertility it is possible that with intensive utilization of grass, and a generous application in the form of artificial fertilizers, of the major elements, the available supplies of minerals such as copper, magnesium, etc., may in the course of time become partially exhausted—not perhaps to such a degree as to reduce observably plant growth, but enough to cause animal ill-health or inefficiency. If such a position were to arise the presence of deep-rooted herbs in the pasture might again be beneficial.

The grazing preferences of animals for these herbs have been taken by some observers as an indication of their mineral value, but on the other hand it has to be remembered that grasses commonly regarded as shallow rooted (such as the ryegrasses) penetrate into the soil to a depth of two or three feet, and that critical evidence of even the simplest one grass/one clover pasture being deficient in the minor elements, has not so far been obtained.

THE USE OF HOME-GROWN CROPS FOR WINTER FEEDING

S. M. Boden, B.Sc., A.R.I.C.
National Agricultural Advisory Service, Yorks and Lancs Province

The emphasis which continues to be laid upon farm self-sufficiency has, as its corollary, the best possible use of home-grown feedingstuffs. Mr. Boden shows briefly the relative values in feeding that should be borne in mind.

THERE can be few things more familiar to the farmer of today than the cry that he should make his farming self-sufficient. He has been exhorted to this end for a dozen years. The same urgency obtains today and indeed, by all the tokens, self-sufficiency must remain a permanent goal until it is permanently attained. The aim of what follows is to show in some measure the contribution that various home-grown crops can make to the problem of finding winter keep for the chief classes of farm stock.

Silage The feeding value of silage is governed by five main factors : (a) the fertility of the soil ; (b) the botanical composition of the crop ensiled ; (c) the stage of growth reached when ensiled ; (d) the type of fermentation undergone in the silo ; (e) the amount of water in the finished silage. Each one of these affects the amount of digestible protein and starch equivalent which will be found in a given weight of silage. Thus a well-fertilized soil yields crops with a better composition ; a crop rich in legumes contains more protein than one poor in them ; a young crop has a higher percentage of protein than one which is more mature ; a well-fermented silage has more digestible protein than one which is underheated

and very much more than one that is overheated ; and, lastly, *all these other things being equal*, the food value is proportional to the quantity of dry matter present. The italics are necessary because mature and overheated silages tend naturally to contain a high dry matter percentage, but such silages are nutritionally poor.

To make recommendations for feeding silage is therefore not a simple affair ; silages really require to be assessed individually, either by long experience which enables the farmer to know how similar silages have performed in the past, or by an adviser's inspection and analysis until such time as the farmer has acquired that knowledge. Quoting the experience of others with silage is valid only if we are in possession of all the facts about quality ; fortunately, nowadays, these facts are usually adequately supplied by authors.

The quantity of silage a farmer makes is no doubt dictated by many considerations but, unless there is a special reason for limitation, he would do well to consider whether he makes all that his stock can consume, because the conventional 40 lb. of silage per head per day has been shown to be far below the capacity of the average cow or bullock. The quality, in respect of crop maturity, must be dependent on the quantity it is intended to feed. Briefly it may be said that small quantities of silage intended to be fed with hay, cereals, straw, and so forth, must be of high protein quality ; while large quantities, intended for use with the minimum of supplements (or even as the sole feed in some few instances) need be of only medium quality. High-quality silage has a balance of nutrients similar to that of a balanced dairy cake, and it would therefore be wasteful to use it also to cover the much less exacting requirements for body maintenance. Using medium quality silage in the " silage only " system, strikes a nice balance between the two contrasting requirements of milk and maintenance, and there is the further advantage that the maturer material gives a greater weight at cutting-time.

In the necessarily short treatment that follows it will be assumed that the factors (*a*), (*d*) and (*e*), alluded to above, are normal for the silages (although recognition of the norms requires experience), and attention will be directed mainly to (*b*) and (*c*).

For Dairy Cows. Silage of high protein quality, capable of producing a gallon of milk when given at the rate of 20–25 lb. (depending on dry matter percentage) is derived from grass in the leafy stage or not more than just heading, from clovers and lucerne up to the early-flowering stage, from mixtures of these, and from young leafy kale ; in the case of kale silage, 30–35 lb. is required, owing to its higher moisture. There is no reason why at least 3 gallons should not be obtained from high protein silage ; the necessary weight of silage, about 70 lb., is within the capacity of the average cow and leaves ample room for maintenance foods. Of course, the attainment of a large consumption of silage may have to be reached by gradual stages. Just how large a final consumption can be reached is shown by the fact that cows have been fed on silage only, consuming up to 150 lb. daily and producing a high gallonage of milk as well as maintaining themselves.

Medium-quality silage, not rich enough to be a cake replacer by itself, can contribute both to maintenance and to production. 50 lb. of an average silage of this type could provide for 1 gallon as well as for half the maintenance ration. Into this category come grass silage made at the early-flowering stage, cereal-legume mixtures, mature kale, mature clover and grass mixtures (rich in clover), and clean sugar beet tops. It is not usually

advisable to feed more than 50 lb. of beet top silage per day, otherwise taints may occur in the milk. The risk of taints from any kind of silage is minimized by feeding immediately *after* milking.

Low-grade silages, such as those from grass in full flower and mature cereal-legume mixtures, are merely hay equivalents and there is no justification for making them deliberately ; the former may arise, however, from the salvaging of hay in bad weather.

For Fattening Cattle. The use of silage for beef animals can eliminate protein concentrates altogether, and satisfactory gains can be obtained on 60 lb. or more of medium quality silage plus 4 or 5 lb. of oats or dried beet pulp, together with hay and straw to appetite. It is possible to give larger amounts than this, and Northern Ireland workers have used medium grass silage alone in amounts exceeding 1 cwt. per head per day for winter fattening of bullocks, commencing at 9 cwt. and finishing at 11 cwt. The diet was rather laxative but the average daily liveweight gain was almost 2½ lb. These workers emphasize that they used grass silage of excellent fermentation quality and suggest that arable crop silage might not do quite so well in view of its lower starch equivalent.

For Calves and Young Stock. Young calves should receive a few pounds of high protein silage each day, the amount being increased according to appetite. Silage of high and medium quality is also valuable for growers, which may receive 20 lb. at nine months increasing to 50 lb. or more at two years. The only other foods needed are roots, hay, or straw, except in the first stages when 2 or 3 lb. of oats or concentrates are required, and the hay should be of the best leafy quality.

For Sheep. Sheep benefit greatly from silage, and 10 lb. or more will be readily taken if it is of good quality and introduced gradually. Sheep given silage in preference to roots are in better condition at lambing time, their lambs are more vigorous, and their milk flow is greater.

For Pigs. Grass silage, unless made from very young leafy material, is not suitable for pigs, owing to their inability to deal with fibre ; and for the same reason arable silages are excluded. Leafy grass silage, however, could be given to the same extent as dried grass, allowance being made for the water present ; thus if 5 lb. of a mixed meal contains ½ lb. dried grass, an equivalent ration would be 4½ lb. meal lacking dried grass plus 2½ lb. best grass silage. This silage would supply the carotene necessary to the pig equally as well as the dried grass. A fibreless silage very useful for pigs is that made from potatoes. Gradually introduced after the pigs have reached 100 lb., it can be fed at the rate of 1 lb. per 20 lb. live weight. Suckling sows can be given 20 lb. per day.

Hay Hay quality is dependent on manurial treatment, botanical composition, stage of growth, and conditions during making and storing; in all of these, the parallels with silage are obvious. Meadow hay made at the early-flowering stage, seeds hay rich in clover, hay of a good colour and smell, have respectively about twice as much digestible protein as meadow hay made when the seed has set, seeds hay poor in clover, or hay badly weathered in the field or seriously browned by heating in the stack. The probable performance of a hay therefore requires as much experience for assessment as does a silage. Really good hay deserves to be rationed as strictly as any concentrate.

The best hay should be reserved for special purposes—high-yielding cows, young calves, and cows and sheep in the last month or two of pregnancy.

Thus 20 lb. of the best meadow hay could maintain a cow and provide for three-quarters of a gallon of milk as well, but 20 lb. of the poorest would barely suffice for maintenance alone. Hay has an important function for cattle at the very end of the winter feeding period. It has been found that the change from winter scarcity to the lushness of spring pastures may have an upsetting effect on the cow unless care is taken to make the change gradually. Lack of fibre in the young grass results in low butterfat percentages in the milk, but this can largely be prevented by providing adequate roughage in the form of hay or straw. Bloat on new pasture can also often be prevented by giving such roughages before turning out.

In the case of sheep, tegs which are being winter fattened may receive ½ to ¾ lb. hay in their rations, and lambing ewes twice as much.

Hay in the ordinary way is much too fibrous for pigs but the debris, which collects at the bottom when stacks are being built or where balers are in action, consists of the leafy portions and the seeds, which can usefully be incorporated, in moderate amount, in pig meals. Alternatively, it should be used wherever the very best hay is desirable.

Leguminous hays are excellent sources of protein but they are very fibrous and their starch equivalents are no better than that of poor meadow hay. Their value lies in their being complementary to foods low in protein.

Dried Grass Welcome legislation which came into force in August, 1951, obliges this, and other dried green foods, to be sold subject to a declaration of protein content. Material containing 13 per cent of protein and upwards (calculated on its possessing an average moisture content of 10 per cent) is approximately fit for milk production, the quantity required per gallon falling from a little over 5½ lb. at the bottom of the scale, to about 4½ lb. for high protein figures. This quality is also suitable for inclusion in pig meals to the extent of about 10 per cent, its value being for its carotene as well as for its protein. Second-class material containing between 13 and 10 per cent protein corresponds roughly in function to medium quality silage, i.e., partly for maintenance and partly for production, but it can be fortified with one-quarter or one-third of its weight of high protein cake, or with half its weight of medium protein cake, to fit it for production alone. It is not suitable for pigs, nor, of course, is the third grade material (below 10 per cent protein) which is merely a hay equivalent for cattle or sheep.

The farmer who dries grass for his own use can get an idea of its probable quality from a consideration of the stage of growth of the original crop, as with silage. Since judgment of what is leafy and what is stemmy is often a matter of personal opinion, an advisory analysis may be required to assist here.

Rape Rape is a valuable forage crop for cattle, sheep and pigs in the late autumn and early winter. It is best grazed under the control of an electric fence. It is a succulent feed as it has only about 14 per cent dry matter, but one-fifth of this is protein and it is therefore a watered concentrate.

Workers at Wye have reported that 45 cows were grazed on 9 acres from mid-October to early December, and they estimated that 8½ tons of leaf and stem were utilized per acre, giving 9 lb. high protein dry matter per cow per day. They experienced no trouble from bloat or milk taints. However,

if rape is not grazed but cut and fed to housed cattle, it is a sensible precaution to avoid possible taints by feeding immediately after milking.

Rape is excellent for feeding off by sheep, but if there is a tendency towards bloat, especially when the rape is wet, some dry food should be given to the sheep before they are turned on to the rape so that they will eat less greedily.

Sows have also done well on rape under controlled grazing. Good results have been reported when a basal ration of 2 lb. meal has been supplemented by rape *ad lib*.

Kale It is well-nigh impossible to exaggerate the value of kale, which is rivalled only by excellently managed grass in the food it can furnish from a given acreage. On suitable soil it can be grazed like rape by cattle and sheep and, by appropriate choice of sowing dates, it can be arranged that the kale is ready to be used when the rape is finished. If cut for indoor feeding it should be given after milking or, if grazed, the cows should be turned in after the morning milking, beginning with less than an hour and gradually increasing to a maximum of two hours. The amount of kale consumed in two hours is probably about 60 lb. and this, with 15 lb. hay, could cover maintenance and 1½ gallons. Allowing for wastage, an acre of an average crop should last 6 cows for three months.

Bullocks of 9 cwt. live weight could fatten at the rate of 2 lb. per day on a ration of 60 lb. kale with 6 lb. crushed cereals and straw *ad lib*. Chopped kale is an excellent tonic food for calves when given at the rate of a few pounds per day, for it is a good source of carotene and minerals ; these, of course, are part of its value for other stock also.

An acre of kale will allow 40 tegs to be folded for three months. When the kale is supplemented with an average daily allowance per head of ¾ lb. each of hay and crushed cereals, good liveweight gains are made.

Kale is valuable for all classes of swine ; about 7 lb. kale is equivalent to 1 lb. meal. It should be chopped before use and introduced at the rate of about 2 lb. daily for pigs of about 60 lb. live weight, increasing gradually to 14 lb. The carotene and minerals already mentioned are especially useful for pigs.

The feeding value of kale as silage has been indicated in the silage section.

Potatoes Potatoes unfit for human use, or surplus to requirements, are an excellent source of digestible starch for animals. In feeding value they are equal to twice or thrice their weight of mangolds or swedes, or one-quarter their weight of cereal grain, and this indicates how they should be utilized.

Raw potatoes, if clean and free from sprouts, are suitable for adult cattle but not for young stock. They are best fed sliced and, for cows, the amount given daily should be increased gradually from about 5 lb. to 15 or 20 lb. at most. Fattening cattle may receive double this quantity, and sheep of 100 lb. live weight about 4 lb. Pigs over 90 lb. may begin to receive them gradually, the eventual limit being 10 lb. Sows may receive up to 18 lb. in early pregnancy, but neither cows, ewes, nor sows should be given raw potatoes when pregnancy is nearing an end.

Experience is divided on whether the cost of cooking is regained in the increased digestibility, but cooking removes the undesirable solanin present in sprouts and green tubers and also renders diseased and damaged tubers safe. Certainly, pigs digest cooked potatoes so thoroughly that none of the

starch reaches the large intestine, but recent work has shown that uncooked starch may be useful there by supplying food for bacteria which manufacture vitamins of benefit to the animal. Pigs can consume more cooked potatoes than uncooked, up to 15 or 20 lb. at the end of fattening, and only cooked potatoes are fit for young stock of any kind; cooked potatoes also make good silage for pigs.

Finally, it is necessary to remember that potatoes are deficient in both protein and mineral matter, and other foods containing adequate amounts of these must be given at the same time.

Beet The use of fodder beet has been so recently and adequately reviewed in this JOURNAL (September, 1951) that little need be said here. It is well to note the varying proportion of dry matter in different members of the family and also to realize that much experience must be gained regarding their performance in different parts of this country before firm recommendations can be made. Their chief advantages over mangolds are : (1) they can be used without a storage period ; (2) those with high dry matter are particularly suitable for pigs. When shredded and fed *ad lib* with a fixed amount of meal especially rich in protein, about 5 lb. of high dry matter fodder beet replaces 1 lb. of meal.

The tops of both fodder and sugar beets are excellent foods which are too often wasted, the fresh material amounting to as much as 9 or 10 tons per acre with a composition similar to that of kale. Like kale, they may be ensiled ; but if they are fed off the ground they should be allowed to wilt for a week or a fortnight before they are used in order to avoid scouring. The use of 2–3 lb. of ground chalk per ton of tops is an additional precaution. An ample supply of water is necessary as cattle become very thirsty on this food.

To avoid milk taints, cows should not receive more than 50 lb. per day and the tops should be fed immediately after milking. This quantity, plus 14 lb. hay and 1 lb. or so of crushed oats, would suffice for maintenance and one gallon.

Tops have been found to have a value similar to swedes for fattening cattle, and considerably more can be given to these than to cows. The produce of an acre is sufficient to keep 100 ewes for a week and, although not quite so efficient as swedes, they are useful also for fattening sheep. Sows do well when folded on tops and require only a pound or two of meal in addition ; up to 15 lb. can be given to pigs in the later stages of fattening, this quantity replacing 2 lb. of meal.

It is preferable not to give beet tops to very young animals of any kind, owing to the risk of scouring.

This review of available winter feedingstuffs is necessarily sketchy and, in attempting to cover a fair number, much important detail has had to be sacrificed. Nothing has been said, for example, about winter grazing of grassland although this has been advocated, where conditions make it physically possible by the provision of foggage and by growing cocksfoot in rows. Also, owing to the diversity of farming practice, it has been necessary to avoid rigid recipes for rations and to be content with indications of equalities and substitute values.

REARING DAIRY-BRED CALVES FOR BEEF

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More beef must come as a by-product of our milking herds. Some interesting experiments carried out at the Cambridge University Farm show that by doing the calves well at the start, they fatten better at an earlier age and so give a quicker turnover.

IT is freely admitted on all sides that there is room for a considerable expansion in beef production in this country at the present time. To a great extent the production of beef depends upon the supply of suitable store cattle. There is little doubt that many more cattle could be fattened each year in this country if larger supplies of suitable stores were available, for the modern practice of ley farming has revolutionized the fattening of cattle on grass. Until a few years ago a large proportion of cattle were fattened in yards and the remainder fattened on old pasture. Winter fattening daily becomes less profitable, owing to the high cost of concentrates. The amount of old fattening pasture was always strictly limited but, as a result of the more widespread use of leys, the area of grass capable of fattening cattle has increased considerably. Much land, particularly the stronger land, even in areas where in the past no grass fattening was ever thought to be possible, is capable, when sown down to a ley, of fattening cattle to Grade A+ and Special quality without the help of any concentrates. Where are the stores to come from if this desired expansion in beef production is to be achieved ?

Stores—from the Dairy Herd An increase in the number of beef-bred stores coming from hill and marginal farms would be a welcome addition to the supply, but it is now generally admitted that the raw material for any great expansion in beef production must come as a by-product from milk-producing herds. The milking industry must contribute a large number of calves suitable for rearing as beef. Not all calves born in milking herds are suitable for beef production. For obvious reasons calves from the extreme dairy types and their crosses must be discounted ; it is wasteful of good food to attempt to rear such calves for beef. However, there are, in this country, a very large number of cows which, though they are profitable milk producers, have the frame and conformation which make them well suited to produce steers for raising as beef cattle. Calves out of dual-purpose cows (Dairy Shorthorn, Red Poll, etc.), either pure-bred or sired by a beef bull, are certainly suitable for rearing for beef, and should indeed be reared for this purpose. So also are calves from the modern deep-bodied, thick type of Friesian cow. Experience suggests that such calves can make good beef, provided that they are well reared in the first place. That is the secret of success in this matter.

On the question of utilizing such " dairy-bred " calves for beef (and there is no doubt that such calves must be utilized if the desired expansion in beef production is to be realized), two questions are worthy of close study :

1. How should the calves bred in milking herds be reared to make good beef ?
2. Can these dairy-bred calves be reared profitably for beef purposes ?

A long-term experiment on the subject of rearing cattle for beef purposes which has been in progress on the Cambridge University Farm since 1946, throws considerable light on these problems. Essentially the experiment

is designed to compare animals bred in milking herds (i.e., of dairy and dual-purpose breeds) with those of a beef breed in respect of rate of growth, changes in conformation and final beef carcass produced on various levels of feeding, and to assess the relative effect of breed and of nutrition level in beef production.

In the spring of 1946 and in each year since, a batch of twenty-four steer calves has been started, consisting of eight of each of three breeds, Hereford, Dairy Shorthorn, and Friesian. So far, only spring-born calves have been used in this work, but it is hoped to repeat the experiments with autumn-born calves in the near future. The twenty-four calves are divided into two equal lots, each containing four calves of each breed, and one lot is reared on a high plane and the other lot on a moderate plane up to eight months old. The high plane is comparable to the level of nutrition on which beef calves are normally reared in beef breeding herds, whereas the moderate level is typical of the feeding adopted in rearing calves on many dairy farms. In this way it should be possible to find out how the beef-bred calf will do when reared like a dairy calf, and how the dairy calf reacts to typical beef rearing.

The high plane is obtained by suckling calves (of all three breeds) in batches for six months on Dairy Shorthorn nurse cows, two or three per cow, depending on the yield of the cow. From a month old the calves receive a liberal allowance of hay and concentrates, and this ration is continued after suckling ends, up to the age of eight months. The maximum daily allowance is 6 lb. concentrates and 7 lb. hay per head. Calves reared on the moderate plane initially receive 40 gallons of milk fed from a pail in the first nine weeks of their lives, supplemented by a restricted amount of concentrates and hay. These foods are again started at a month old, and continue up to eight months, the maximum allowance being 2½ lb. concentrates and 5 lb. hay per head per day.

Experiments with Four Feeding Treatments At eight months old the two groups are further subdivided, thus giving four feeding treatments :

1. High plane up to eight months, followed by high plane (High-High).
2. High plane up to eight months, followed by moderate plane (High-Moderate).
3. Moderate plane up to eight months, followed by high plane (Moderate-High).
4. Moderate plane up to eight months, followed by moderate plane (Moderate-Moderate).

After the first eight months the high and moderate planes apply only to winter feeding ; during the summer all the cattle are turned out together at grass. During these subsequent winter periods the high-high and moderate-high groups are fed on a generous ration of concentrates and good hay, calculated to produce a liveweight increase of about 2 lb. per head per day. The other two groups (high-moderate and moderate-moderate) by contrast are fed on a "store" ration, composed in the first winter of poorer quality hay, much more straw and very little concentrates, and in subsequent winters they receive no hay, roots or silage whatsoever but live in yards, largely on wheat straw supplemented by a very small quantity of concentrated food. On suitable land these cattle could be outwintered, and would probably be all the better for such treatment. There is, therefore, a very marked contrast between the high and moderate level of feeding in this experiment.

In each year, therefore, there are two steers of each of the three breeds on each of the four feeding treatments. To obtain sufficient numbers to give all the data required, it will be necessary to rear eight or nine batches of cattle, but already from the first three batches completed it is possible to draw certain conclusions on the effect of the feeding treatments on the growth development of the animals.

All calves are weighed within the first week of their lives, and again regularly every two months throughout life. All food fed to the cattle is weighed daily and recorded, so that the amount received by each group is known.

The cattle are reared to at least two years old and then slaughtered as soon as it is estimated that they will dress out at 57 per cent (Grade A+). So far all the cattle born in 1946, 1947 and 1948 have been slaughtered, and to date all cattle have graded at least A+. Not all the cattle born in one year are ready for slaughter at the same time ; in fact, there is a very great difference between feeding treatments, as can be seen from Table 1. The results discussed in this article are in respect of the cattle born in 1946, 1947, and 1948, and from the look of the groups born in succeeding years it is unlikely that any serious alterations will have to be made in these conclusions.

Table 1

Average Age and Live Weight at Slaughter

Treatment	Age at Slaughter	Where Fattened	Weight Paid For
	years		*cwt.*
High-High	2	Yards (winter)	11
High-Moderate	2½	Grass (summer)	11½
Moderate-High	2	Yards (winter)	10
Moderate-Moderate	3½	Grass (summer)	12

At the end of the calf period the high plane calves (high-high and high-moderate) are almost exactly double the weight of the moderate calves (5 cwt., as compared with 2½ cwt.). Long after the nutrition treatments are subdivided at eight months the difference in size between calves reared on a high or moderate plane initially remains visible. At the end of the first winter (when the cattle are just over a year old) the high-high cattle are almost 1 cwt. heavier than the high-moderates and 2 cwt. heavier than the moderate-highs. The latter group are nearly 1½ cwt. heavier than the moderate-moderate cattle. In spite of the high feeding given to the moderate-high cattle during their first winter, they are almost 1 cwt. lighter than the high-moderates at the end of this period. In fact, it is not until the end of the second winter (i.e., after two winters of high feeding) that they reach the weight of the high-moderates at the same age, and in doing this they will have eaten a much greater quantity of concentrates than the high-moderates.

Initial High Feeding Means Earlier Fattening Both the high-high and moderate-high groups are fat at the end of their second winter (i.e., about two years old) the former being about 1 cwt. heavier than the latter. During the third summer the high-moderate cattle grow rapidly and fatten readily, increasing in weight by 2½ cwt. The moderate-moderate cattle, on the other hand, continue to grow during their third summer, but do not fatten. After a further winter on a moderate level of feeding they will fatten fairly easily in their fourth summer. Thus these cattle have to be kept for a whole year longer than the high-moderates, and this despite the fact that both groups of cattle are on the same level of feeding

from eight months onwards. By rearing calves on a high plane initially, therefore, it is possible to save a year, and the rate of turnover is thereby greatly increased. In fact, on the moderate-moderate type of feeding, cattle cannot be fattened at young ages and medium weights. From the experience gained in this experiment this applies particularly to the dairy-bred steers which must be done well as calves if they are to grow into good beef animals by the time they are 2½ years old.

The food consumption of the four groups, given in Table 2, shows that far less concentrates and hay are consumed by the high-moderate and moderate-moderate groups than by either of the others.

Table 2

Total Food Consumption per Head (excluding straw and grazing)

(Average for three batches born in 1946, 1947, 1948)

	H – H	H – M	M – H	M – M
Milk	Multiple Suckled 6 Months	Multiple Suckled 6 Months	Gallons 40	Gallons 40
Concentrates (including sugar beet pulp)	*cwt.* *qr.* *lb.* 38 1 5	*cwt.* *qr.* *lb.* 22 0 15	*cwt.* *qr.* *lb.* 32 2 23	*cwt.* *qr.* *lb.* 23 1 25
Hay	34 1 7	18 3 17	28 0 11	16 1 12

These figures do not include straw and summer grazing. If the above figures are converted into terms of starch equivalent, it is found that the high-high cattle consume 71 per cent more food per live hundredweight than the high-moderates. The really interesting comparison is between the two opposites, high-moderate and moderate-high. The latter consumed on average 50 per cent more food per live hundredweight than the high-moderates. This means that by using the high-moderate system of rearing, three cattle can be reared from birth to slaughter on the same amount of concentrates and hay that would be required to rear and finish two cattle reared moderately as calves and high afterwards. The explanation of this is quite simple. By generous feeding for the first eight months the calf is hurried through the stages of growth when it can utilize only highly digestible foods of a high feeding value (milk and concentrates) and these, of course, are the expensive foods. In this way it grows quickly and soon reaches a stage when it can make good use of roughages, whereas a calf reared on a moderate level initially cannot deal with cheap bulky foods so effectively at the same age. Moreover, the well-reared calf eats concentrates at a time when its appetite is fairly small, whereas the calf reared moderately up to eight months, and then put on to a high plane is larger than a baby calf, and consequently has a much bigger appetite. It must, therefore, eat more concentrates in its life than its fellow which is given a good start.

So far the evidence is in favour of giving the calf a good start in life, but does it pay ? The answer to this question is given in Table 3. In preparing this estimate of the cost of production of cattle reared on the four feeding treatments, concentrates (except sugar beet pulp) have been charged at £30 per ton, and all other foods on a cost of production basis on the University Farm in 1951. The same basis of charging for food, grazing, labour,

housing and all other items has been used for all groups so that the figures are valid for comparative purposes. The return shown in the table is based on the new 1951 prices for fat cattle according to the time of slaughter, the grades being super-special (59 per cent) for the high-high and moderate-high groups, and special grade (58 per cent) for the other two groups finished on grass.

Table 3

Estimated Cost of Production and Estimated Profit per Head

	High-High			High-Moderate			Moderate-High			Moderate-Moderate		
	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
Cost of calf	6	10	0	6	10	0	6	10	0	6	10	0
First year	43	11	6	35	6	5	28	5	5	21	4	0
Second year	29	14	10	15	15	10	32	16	9	15	0	7
Third year		—		3	4	0		—		15	14	7
Fourth year		—			—			—		3	4	0
Total Cost	**79**	**16**	**4**	**60**	**16**	**3**	**67**	**12**	**2**	**61**	**13**	**2**
Return												
Sale of bullock ..	73	16	9	71	17	2	67	2	6	76	13	0
Calf subsidy	5	0	0	5	0	0	5	0	0	5	0	0
	78	16	9	76	17	2	72	2	6	81	13	0
Profit (or Loss) per head	—	19	7	+16	0	11	+ 4	10	4	+19	19	10
Profit (or Loss) per year of animal's life	—	9	9½	+ 6	8	4	+ 2	5	2	+ 5	14	3

From this table it can be seen that the high-high cattle are unprofitable. Too much money has been spent on them during their lives, and most of their liveweight increase has been gained on expensive concentrates.

The two most profitable groups are the high-moderate and moderate-moderate, but in comparing these two groups it must be remembered that the rate of turnover is much greater in the high-moderate group. Thus three batches of fat cattle reared on the high-moderate system can be sold in the time taken to rear and fatten two lots of moderate-moderate cattle. Hence, the high-moderates show a greater profit per year of life than the moderate-moderates, and over a run of years a greater total profit. A profit of £16 per head for cattle reared well initially and then fed cheaply on roughages and finally fattened on grass is a worthwhile return on the rearing. It is worthy of note that two-thirds of the cost of the rearing on these cattle was spent in the first year of the animal's life.

A Good Start is All-Important These high-moderate cattle show over three times the profit made by the moderate-high group. The attempt to make up for the poorer start in life received by the moderate-high cattle is very costly, and over half the cost of the rearing is spent in the second year. These comparisons show how great a mistake it is to unduly restrict the feeding of young calves on the grounds of economy, since the later rearing will become extremely costly if the animal is to be finished at a young age. It is evident that the total sum of money spent in

rearing a beast from birth to slaughter is of far less importance than the stage of the animal's life at which the money is spent. The time to be generous is in the early stages of the calf's life ; later on one can afford to reduce the expenditure considerably—in fact, it is highly profitable to do so—without any detriment to the animal. It is not suggested that all calves should be suckled for six months, or even that they must all be suckled. Multiple suckling is undoubtedly a good system of rearing where it is practicable but whatever system of calf rearing is adopted it should be on a *generous* scale. A good start enables calves to make much better use subsequently of the cheaper bulky foods and grazing, and saves a good deal of expensive feeding of concentrates in the long run. With prices of concentrates at the present high level it is imperative that these foods should be used to the best possible advantage. The ability of the ruminant animal to convert large quantities of home-grown roughages—grass in summer and hay, straw and other bulky foods in winter—into meat and fat is now more important than ever and is an asset that must be exploited to the fullest possible extent. This must involve producing most of our beef from grass.

At present-day prices the moderate-moderate group may not appear unattractive, but it must be emphasized that many more difficulties arise with calves reared on a moderate level than with those reared well. Some of the troubles (e.g., scouring and chills) commonly experienced when calves are not reared very well, have occurred during the course of this experiment among the moderate calves, and an occasional calf has been lost. No such troubles have been experienced with the calves reared on the high plane. There is, therefore, a considerable risk with moderately reared calves, and although it has not been charged in Table 3 it must be borne in mind.

In conclusion, it would appear that the ideal way of producing beef from suitable dairy-bred calves—and for that matter from beef-bred calves, too—is to rear them well up to eight months old, to follow with a store period of about 18 months during which the cattle should be kept just growing, and finally to finish them on grass. A good start is all-important. In this way beef cattle can be reared with profit to the farmer and to the satisfaction of the consumer.

MECHANIZED SUGAR BEET HARVESTING

OSWALD ROSE

British Sugar Corporation Ltd.

The difficulties of mechanical sugar beet harvesting are gradually being overcome. Mr. Rose's article details some results of the research already carried out in this field, with special reference to experience in 1950.

IN 1950 nearly 14 per cent of the British sugar beet crop was harvested mechanically, and the indications are that during the present season about 20 per cent will be dealt with in this manner. Considering that only four years ago (1947) the relative figure was less than 1½ per cent, it can with reason be claimed that fairly rapid progress has been made. This unquestionably reflects the greatest possible credit on the agricultural engineers and farmers concerned, whose combined efforts have pointed the way towards vastly increased output per man, and a substantial lowering of costs. The former is well illustrated by the performance of combine sugar beet harvesters operated last year by contractors. Forty-two accounted for over 4,000 acres, with an average of 97.3 acres per machine. In every case two men were employed on the job, and near enough this worked out at 48 acres per man, per season—just eight times greater than the old traditional calculation of a minimum of one man for every six acres grown.

Machine Performance During their frequent visits to farmers in the autumn, the field staff of the British Sugar Corporation collect as much information as possible relating to the output of each individual machine, and the following table has been prepared as a result of the 1950 survey :

Machines Operated and Acreage Harvested

Make of Machine	No. located during Survey	Total No. Operated	Acreage Harvested	Acreage per Machine
Catchpole	599	564	29,303	51.96
Fordson*	304	285	5,368¼	18.84
International ..	17	17	699	41.12
Mern	201	143	1,925	13.46
Roerslev	1,028	834	11,510¾	13.80
Salmon	73	53	1,590¼	30.01
Peter Standen ..	93	89	2,796	31.42
Robot	16	13	259	19.92
Other Machines ..	209	122	2,685	22.01
TOTAL ..	2,540	2,120	56,137	26.48

* Figure limited to instances where this machine has been used in conjunction with some mode of pre-topping. Over 500 additional machines of this make were located during the survey, but the relative figures cannot be included under the heading of "Mechanized Harvesting" since the beets were subsequently handled and topped by hand.

This table shows that approximately two-thirds of the total acreage was dealt with by combine machines, and the other third by the so-called two-stage harvesters. It will also be observed that the harvesters in greatest numbers are the Catchpole (combine) and Roerslev (two-stage), and it is extremely interesting to note that the average acreage harvested per machine,

by these two machines, is in very close relationship to their widely differing initial cost—that is, about an acre for every £10 capital outlay.

Of the 2,500 odd machines located during the past year's survey, 52½ per cent were owned by farmers growing between 1 and 20 acres of sugar beet. In these circumstances it will be appreciated that the average acreage harvested per machine is not a very reliable criterion of their overall seasonal capacity, due of course to the fact that a quite high proportion of them were used only on a limited scale. However, there is ample evidence that some models in the hands of efficient operators are now capable of really prodigious achievements. One harvester accounted for 230 acres and four others passed the 150-acre mark.

At the National Demonstration held in Yorkshire, the organizers allotted sufficient land to manufacturers operating harvesters in the Production Class to require that they should work at the rate of 3 acres per day if the task was to be completed. Seven out of the fourteen got home, three before the prescribed time.

Standard of Efficiency So much for the performance and output. What about the quality of the work? Here again it is necessary to resort to figures and quote from the results of the survey :

In respect of all contracts where machines harvested 90 per cent or more of the entire crop, the tare figures were compiled and compared with the average tares which prevailed at the eighteen factories concerned. The figures represent weighted averages, and the comparison is relative to the percentage of beet harvested mechanically in each factory area :

Year 1950	Dirt Tare (*lb. per cwt.*)	Top Tare (*lb. per cwt.*)	Total Tare (*lb. per cwt.*)
(*a*) Crops harvested by machine	14.43	3.34	17.77
(*b*) Average relative figure for all crops in the same factory area	13.97	2.83	16.80

Apart from a tendency towards increased top tare, the combined figures show that mechanized harvesting does the job almost as effectively as men can do it, but when these figures are subdivided under make classification, the results are not quite so satisfactory, and suggest that either the topping mechanism or the setting of some models calls for improvement.

Make of Machine	Total Acreage on which figs. are based	Dirt Tare	Top Tare	Total Tare
		lb. per cwt.	*lb. per cwt.*	*lb. per cwt.*
Catchpole	11,539	12.92	3.17	16.09
Fordson	2,538	16.20		
International ..	282	18.42	3.57	21.99
Mern	1,232	14.78	3.43	18.21
Roersley	7,055	16.12	3.45	19.57
Salmon	577	14.34	3.68	18.02
Peter Standen ..	932	16.07	3.68	19.75

It may be construed that under-topping is largely compensated by a corresponding reduction in the even more important factor of over-topping, but here again the figures obtained last year at the National Demonstration do not show that this is the case ; on the contrary, the mass of samples taken during the two days indicated that some machines which under-top are at

the same time equally capable of over-topping. Any discussion on comparative dirt tares is bound to point to the important problem of trying to determine what constitutes harmful damage to the roots. So far it appears that the old saying " You can't have it both ways " is a fair summary of the position. Either the roots must be hit by the cleaning mechanism with risk of bruising, or the soil adheres to them.

This is clearly a case for research, and it is good to know that the Sugar Beet Research and Education Committee of the Ministry of Agriculture is this autumn conducting experiments designed to ascertain as far as is possible the extent of the damage incurred, and its subsequent effect on the beets put into clamps.

Method of Harvesting Up to the present time, over 90 per cent of all sugar beet harvested mechanically is left on the ground in windrows, and unless the carters-off keep up with the harvester, there is a real danger of frost damage. Particularly does this apply in the case of combine machines which mutilate the tops to such an extent that they can no longer be used as covering. The solution would therefore seem to be direct loading, thus following American practice where it is not regarded as either economical or logical to pick up the roots and throw them down again. No doubt British farmers would be more likely to adopt this method, but for the fact that loading into trailers drawn alongside requires three tractors, and few farmers can afford to have so many machines tied up on the one job.

Many rear trailer attachments are making their way on to the market, and if this method eventually becomes widely adopted, mechanized sugar beet harvesting will be more economic and certainly less hazardous during frosty weather. Present experience in this direction indicates that whilst it is quite feasible to accomplish both jobs at once, and with one tractor, there does come a time, every now and then, and particularly during wet periods, when the tractor has enough to do to pull just the harvester alone. It is therefore obvious that an easy and quick conversion from trailer drawing to the windrowing method, would greatly facilitate this form of development.

Two-Stage Harvesting. In October, 1948, two comparatively small Danish harvesters were imported to take part in the third National Sugar Beet Harvesting Demonstration at Fakenham. These machines consisted of two separate units—one for topping and the other for lifting, cleaning and windrowing ; they made such a good impression that their debut may be fairly described as sensational. In less than two years over 1,200 took the field to help harvest the record 1950 sugar beet crop. Being less than one-third of the price of most of the combine machines, they appealed particularly to the smaller acreage growers and to the farmers who wished to save their tops in good condition.

In actual fact, removing the tops prior to lifting is no innovation, and has been practised in Europe for many years, long enough anyway for the farmers of those countries to appreciate that there is a grave risk of losing sugar if the topping is too far in advance of lifting. Research investigations in England during the past four years confirm these results, and it has been shown that even a delay of forty-eight hours can cause substantial losses.

Partial Mechanization. In the process of the development of mechanized sugar beet harvesting, there has emerged a method of dealing with the crop which, for want of a better expression, may be described as "Partial Mechanization". It consists of lifting the beets—in the case of some machines, two rows at a time—and, after subjection to a cleaning process, the roots

are left on the surface to be subsequently collected and topped by hand. Just under 10,000 acres were accounted for in this manner during 1950, and the indications are that this method requires less manual effort than the normal lifting practice, and is consequently more economical. It is, however, absolutely essential for the manual labour to keep right up with the machine in frosty weather. The survey discloses that whilst the total estimated losses due to frost damage sustained by all growers using sugar beet harvesters was less than the comparable figure for the normal hand harvesting method, the practice referred to above resulted in much heavier losses. This disclosure does not, of course, reflect adversely on the method as such; it merely points to the fact that farmers adopting it should be particularly watchful that the necessary precautions are taken.

The Second Crop In many parts of Europe the term "second crop" is frequently used when speaking of tops and crowns, and it is no exaggeration to say that the great majority of sugar beet growers in those countries regard this crop as of equal importance to the roots. Last November the writer had occasion to travel through Holland, Denmark and Sweden, and apart from two fields in the latter country, did not notice one single instance of tops being ploughed in. It is estimated that at least 98 per cent are used for feeding purposes. The comparative figure for Great Britain during last year was 58 per cent, and for the past four years as follows :

1947	1948	1949	1950
per cent	*per cent*	*per cent*	*per cent*
64	54	60	58

There is no indication of an improvement, and on average 41 per cent of the tops are ploughed in. The use of them varies considerably in different parts of the country, as will be seen from the table on the opposite page.

Even when due allowance is made for the difficulty of handling vast acreages of roots during a wet autumn, it does really seem strange that the steep rise in the cost of feedingstuffs did not tempt more farmers to make silage—only 232 out of 40,890 attempted it.

Perhaps we make the job appear far more difficult than it really is. Most Danish and Dutch farmers use the so called "quick-filling cold method," having long ago given up the practice of high temperature control and its attendant need for intermittent filling. Clearly this appears to be a problem worthy of much greater attention, and any action which will result in better use being made of the two million or so tons of tops which are annually ploughed into the soil, will be of national importance.

Future Development Whilst it is obvious that mechanical sugar beet harvesting is now an established practice, it is equally clear that innumerable problems lie ahead. Perhaps the most disturbing feature last year was the number of instances where, in the late autumn, farmers were obliged to abandon their machines and finish harvesting by hand—a state of affairs which is both costly and dangerous. Similarly, little headway has yet been made in areas where the soil type is either very heavy or particularly stony. In regard to the latter, there seems to be a strong case for further tests of models where the topping mechanism is fitted above ground level, and away from the risk of excessive damage.

Disposal of Tops and Crowns

Factory	Percentage Fed	Method of Feeding			
		Percentage Carted Off and Fed Fresh	Percentage Fed on the Field	Percentage Ensiled	Percentage Dried Artificially
Cupar	94.1	37.98	59.21	2.69	0.12
Allscott ..	90.5	46.10	53.81	0.09	—
Kidderminster	85.5	50.04	48.11	1.85	—
Southern Area*	81.7	67.45	29.80	2.75	—
Kelham ..	81.1	33.65	65.01	1.34	—
Poppleton ..	78.0	38.17	61.27	0.56	—
Wissington ..	71.8	54.37	43.53	1.07	1.03
Colwick ..	71.6	65.98	30.79	3.23	—
Ipswich ..	62.6	84.62	14.13	0.72	0.53
Felsted ..	62.5	69.26	25.39	4.98	0.37
Cantley ..	57.0	83.51	14.81	1.68	—
King's Lynn ..	54.6	68.22	31.78	—	—
Bury St. Edmunds	51.3	68.57	30.35	1.08	—
Bardney ..	46.2	21.03	78.97	—	—
Brigg	43.2	18.47	81.40	0.13	—
Selby	43.0	66.92	29.76	3.32	—
Spalding ..	39.7	67.96	31.73	0.31	—
Peterborough	33.2	34.13	65.27	0.60	—
Ely	29.3	47.77	50.61	0.66	0.96
Average for Gt. Britain ..	**58.42**	**58.08**	**40.41**	**1.40**	**0.11**

* This is not a factory but an administrative area.

Reference has already been made to the need for trying to strike a balance between maximum cleaning and minimum root damage. Furthermore, if direct loading is to be adopted on a wide scale, it is reasonable to assume that far more soil will be carted to the clamps than under existing conditions where the normal practice is to expose the roots on the field—frequently for days—either in small heaps or windrows. Direct loading will inevitably focus increased attention on the desirability of acquiring machinery which will combine cleaning with elevating when reloading from the clamps.

With the rise in the price of feedingstuffs, top saving becomes an even more urgent and pressing necessity, and it is therefore gratifying to note the substantial progress made recently by some English manufacturers in this direction. The Swedish approach to this problem is particularly interesting—in that country no form of mechanized harvesting is regarded with favour unless all the leaves and crowns can be saved, and the present very high plant population, which is obtained mainly by growing sugar beet on narrow rows, maintained. Both these factors mitigate against tractors being used in the crop, and for this reason a really stupendous effort has been made in recent years to evolve a machine that will harvest both roots and tops in one operation, and drawn by a tractor operating outside the rows.

MECHANIZED SUGAR BEET HARVESTING

The removal of sugar beet tops from the field is an even more formidable task than carting off the roots ; maybe one solution is to combine a chopper-blower on the harvester, and thereby greatly reduce the volume. These and countless other problems require investigation.

Successful sugar beet harvesting ranks second to none in the achievements of agricultural engineers, and although there can be little doubt that manufacturers will strive unceasingly to raise the efficiency standards of their machines, it must be appreciated that the amount of effort which a commercial firm can put into research is limited ; in order to live, they are obliged to also make, sell and service. In these circumstances it seems reasonable to suppose that future progress depends in no small measure on the help and guidance they can get from research organizations, who are in a better position to devote more time to the scientific aspects.

A fine start has been made, but this must not be allowed to foster any form of complacency which could easily lead to haphazard and desultory development, with all its attendant repercussions on both the agricultural and industrial interests. There can be little doubt that future progress depends largely on the enthusiastic and co-operative effort of all parties concerned.

ANNUAL REPORT OF THE BRITISH COUNCIL, 1950-51

The promotion of cultural relations with other countries is now accepted as a normal and, indeed, an essential function of the State. Because of its nature, however, it does not lend itself to any spectacular publicity and for that reason, it may be overlooked. In this field the British Council shows by a wealth of information and statistics in its annual report the scope and diversity of the work which it quietly and steadily pursues.

To spread the fullest understanding of the history and way of life of the British people the Council operates as a trader of artistic and scientific knowledge ; on the one hand by means of its educational and cultural institutions or centres overseas and advisory visits and, on the other by the sponsorship of study programmes, courses and scholarships in Britain. Some 130 lecturers paid 209 visits to no less than 54 countries on various aspects of national institutions and achievements. Of these lecturers some six or seven dealt specifically with agricultural subjects visiting, during their tours, Europe, S. America, the Middle East and India. In addition exhibitions of books and periodicals were staged on forty-nine occasions and, where appropriate, literature of an agricultural nature was included. At home, too, courses organized by the Council included such agricultural subjects as Dairy Technology and Forestry.

HIGH FARMING ON A NORTHAMPTONSHIRE REDLAND FARM

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County Agricultural Officer, Northamptonshire

Getting more from every acre is the maxim of Mr. Dennis Hutchinson, who farms 350 acres on the redland soil of the Midlands. His system rests upon the twin pillars of balance in self-sufficiency and coordination.

THERE are several distinct types of soil in Northamptonshire. One of these, the ironstone marl, or Northamptonshire redland, covers a fairly large area of the county. Although it may have some features resembling the red soil derived from the Old Red Sandstone formation of the West Country, it has a different origin and varies in many respects from those soils. The Northamptonshire redlands are light, easily worked and usually free draining, although wet areas often arise where the ironstone outcrops; as a rule they are rather shallow and stony. Under grass they readily burn up in a dry summer, and under arable crops they are prone to grow annual weeds. They give the best results during a wet season. This land is, therefore, not inherently fertile and is more suitable for growing arable crops than permanent grass. But to continue growing arable crops, it is necessary to maintain a high state of fertility, and in the Midlands we believe that soil fertility is best maintained by having livestock on the farm.

Mr. Dennis Hutchinson's Farm The 350-acre holding of Mr. Dennis Hutchinson at Cransley Grange, near Kettering, has a high proportion of this soil type. There is always an air of tidiness and efficiency about this farm which strikes the eye of any farmer or observant traveller on the road between Kettering and Northampton. The farm is less than three miles from Kettering and lies along a ridge running in an east to west direction. Along the crest of this ridge is the main Northampton-Kettering road. The highest point is just above the 350 feet contour. On either side of the ridge below the 275 feet contour the land falls away in a gradual slope—of roughly 1 in 6. The outcrop of the ironstone occurs at about the 300 feet contour, and below this, in the valleys, the soil is fairly heavy alluvium or clay. The higher redland is permanently arable and a five-course rotation is practised.

The valley land on the heavier soils, which was mostly permanent pasture before 1939, was ploughed up during the war, and is now managed under an extensive ley system. It is ploughed up as and when required, carries a rotation of arable crops, and is then returned to a ley. The farm is more or less in a ring fence, with the main road running through the centre. It is fairly well equipped with four sets of buildings, some of which are tenant fixtures, such as implement sheds, implement repair shed and some of the cattle yards. Three groups of buildings lie away from the main homestead, where the store and fattening cattle are wintered. The water supplies, drainage and other fixed equipment are good and quite adequate for the system of farming adopted. There are three cottages which belong to the holding, but most of the workers live in the village.

The general policy on this farm may be summarized as follows :

1. To obtain the maximum output consistent with the maintenance of fertility and cleanliness.
2. To be as nearly self-sufficient as possible between one department of the farm and another and to aim at turning out the finished products as human food—that is, sugar beet, wheat, potatoes, barley, fat cattle, fat sheep, and milk.
3. To endeavour to grow a similar acreage of each crop each year and to carry the same numbers of livestock with a consistent livestock policy. By this means, in spite of seasonal variations in weather and price pulls, a proper balance between fodder crops and cash crops and a level head of livestock can be maintained.

Arable rotation on the redland of 150 acres is :

First year	27 acres sugar beet and 3 acres mangolds on headlands.
Second year	Spring wheat (Atle) or barley.
Third year	Barley.
Fourth year	20 acres peas or beans or one-year's ley, mainly red clover with New Zealand H.I. ryegrass (first cut for hay, second for seed), and 10 acres of potatoes on the area which seems to require special cleaning.
Fifth year	Spring-sown mixed corn for cattle feed. Peas, oats and barley or beans, oats and barley on the heavier land.

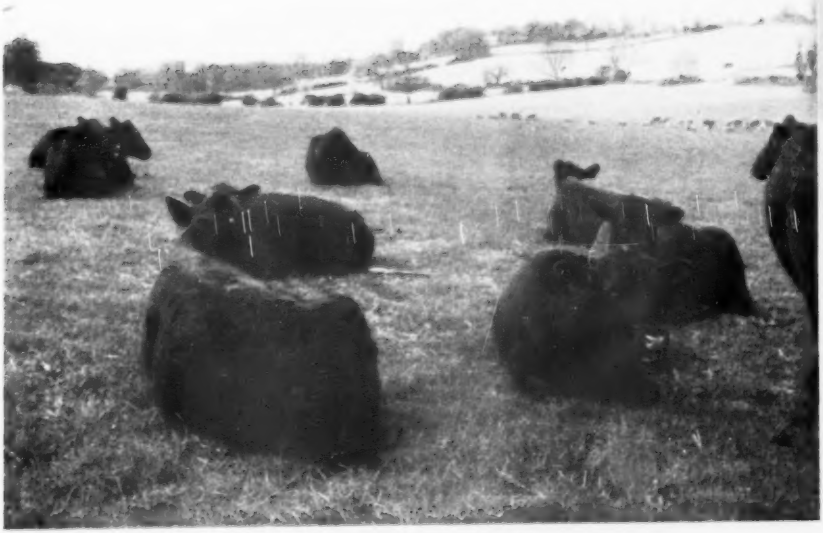
Some slight variations occur in these according to the nature of the soil on the particular field. Some winter wheat may be grown in place of mixed corn on the heavier land. The policy is to have a fairly rigid rotation which is flexible in its application.

Crop yields for 1949 and 1950 were :

	1949	1950
Wheat	29 *cwt.*	30 *cwt.*
Barley	24 ,,	28 ,,
Mixed corn	24 ,,	25 ,,
Seeds	31 ,,	32 ,,
Sugar beet	10 *tons*	18½ *tons*
Potatoes	12 ,,	12 ,,

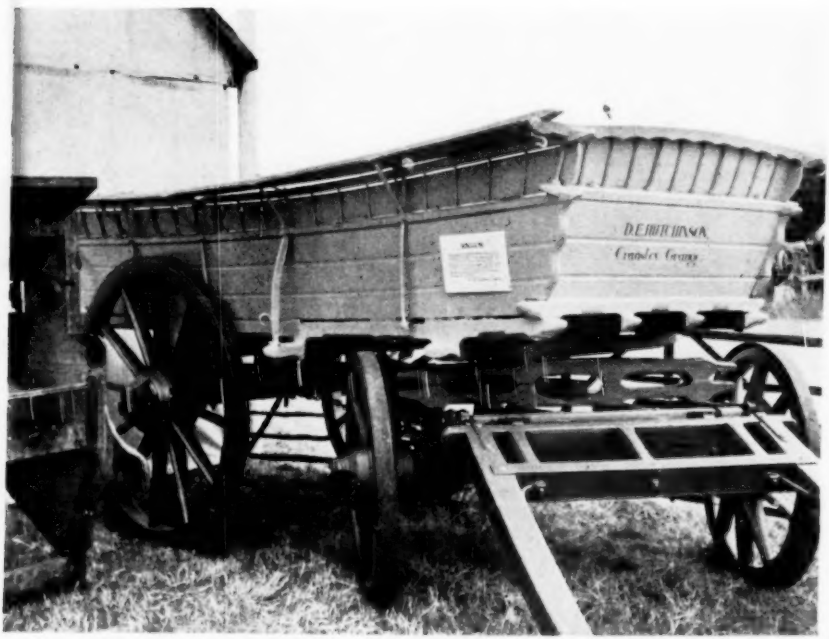
The Use of Lime and Fertilizers The applications of lime and fertilizers are based on the results of soil analysis. On arable land the usual practice is to give fairly liberal dressings of fertilizers for potatoes and sugar beet—10 cwt. National Compound No. 1 for sugar beet and 14 cwt. National Compound No. 1 for potatoes (or the equivalent in unit value of other fertilizers), in addition to farmyard manure. No additional fertilizers are applied to the crops immediately following potatoes or sugar beet, but 3 cwt. of compound fertilizer is applied to the second straw crop. Lime is applied regularly at the rate of 10 cwt. burnt lime per acre every five years on the rootbreak. The *pastures and leys* receive 2 tons ground limestone per acre every four years. This practice was started during the war, when it was found that the broken-up grassland was deficient in lime and its correction made the succeeding grassland very much more productive. All grassland receives 7 cwt. per acre high-grade slag every two or three years. Nitrogenous fertilizers are used for early bite and for hay at the rates of 1½ cwt. per acre " Nitro-Chalk " for early bite and 2 cwt. per acre for hay. The usual practice is to get an early bite from the first-year leys ; in this way a good establishment is assured, provided it is well grazed. All leys and pastures are periodically topped over.

Yearlings on a ley in the valley



Steers (2½ years old) with the fattening sheep in the background

A springtine weeder at work in a field of spring barley

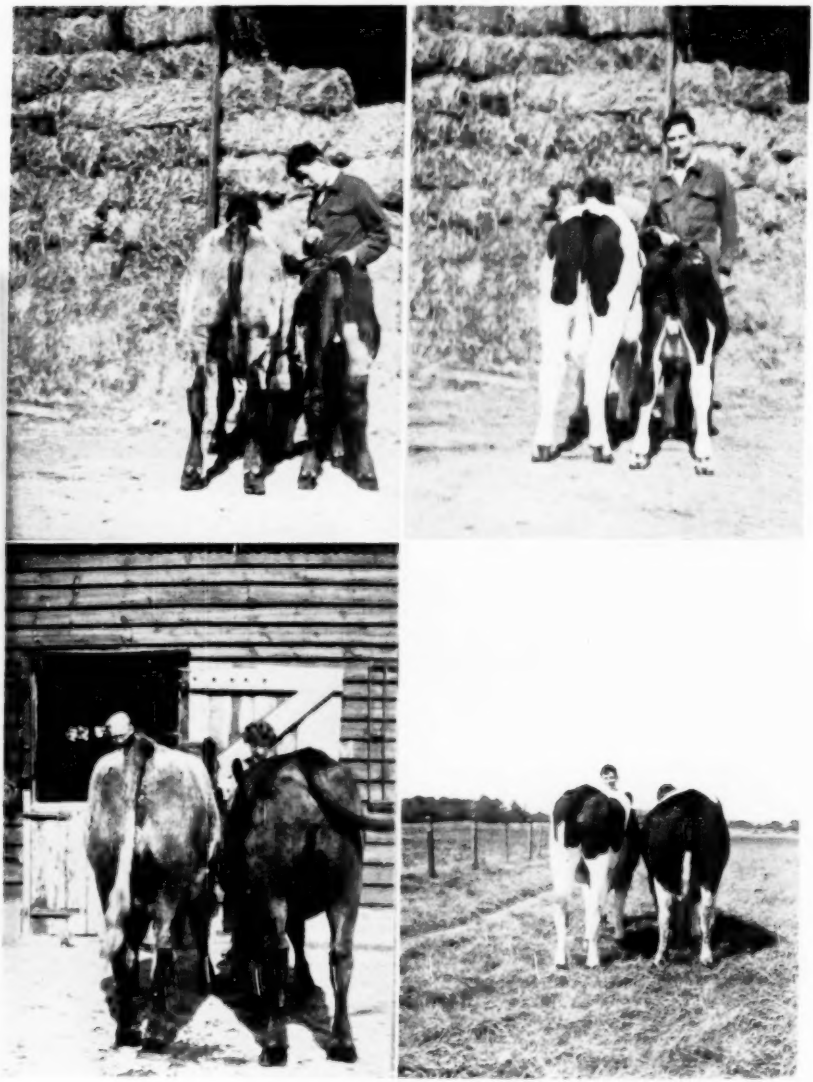


This wagon, which was exhibited both at this year's Royal Agricultural Show and the 1851 Exhibition, is still used occasionally

A reclaimed area which until 1950 was overgrown with bushes and harboured rabbits and other vermin

An example of the wire fences erected between the arable land and the leys

REARING DAIRY-BRED CALVES FOR BEEF (See pp. 365-370).



Dairy Shorthorn and Friesian Steers

Top left and right: Calves at the age of 6 months. In both cases the calf on the left of the photograph was reared on a high plane, the one on the right on a moderate plane.

Bottom left and right: Steers ready for slaughter. In both cases the steer on the left of the photograph is 3½ years old and was reared on a moderate-moderate plane; that on the right is 2½ years old and was raised on a high-moderate plane

Despite the increased price of fertilizers, Mr. Hutchinson is emphatic that he will continue to use the same amount as he has in the past. In his opinion the more difficult times in farming can be overcome only by greater use of fertilizers, although they must always be used efficiently and alongside the maintenance of the humus content of the soil.

In haymaking the aim is to produce a good quality product, and this fits in very well with the system of farming and the equipment available. At an early stage the hay is placed in large North Country "cobs". Using low vehicles fitted with windlasses, the cobs are loaded and transported to where the hay is required for feeding during the winter, there elevated into barns or stacks. Hay is not baled ; processing by either a pick-up or a stationary baler is considered to be too costly and the product more likely to be inferior.

Cattle and Sheep The livestock policy aims at fattening 500 sheep every year and the maintenance of a self-contained herd of 140 pedigree and grading register Red Polls, producing milk and fattening the steers. Thirty-five calves are reared each year, which is the number that can be carried to maturity. The steer calves are reared and fattened in yards during the winter at three years old, and usually graded at about three years three months.

The average yield of milk from the cows is over 900 gallons and the average for the heifers is 720. So far this year, however, some of the heifers have already given 1,000 gallons. The first three daughters of the senior bull have completed 1,000 gallons in the first lactation of 305 days, and 7 bullocks of the same age group by the same sire were graded at three years, an average weight of 11¾ cwt. Three were graded special and four super-specials. With sheep the policy in the main is to purchase stores for fattening. Approximately 300 are fattened on sugar beet tops between mid-October and the end of January. In addition to these, 200 store lambs are bought in the autumn and used as scavengers in the winter. They run over the stubbles before these are ploughed and go on to clean up the pastures. During January, February and March they are kept going with hay, mangolds and a small amount of trough feeding. As soon as the land is dry enough, usually by the end of March, they graze the wheats. From the wheat they are transferred to the leys to utilize the spring flush of grass and are sold fat off the grass by the beginning of July. By this time the cattle are well able to graze adequately all the available pastures.

Mr. Hutchinson believes that silage-making is a sound method of fodder conservation but does not fit into his farming system because it would increase his labour requirements at the time of sugar beet singling and hoeing, prevent his fattening as many sheep on grass and sugar beet tops as he does now, and probably lead to the purchase of additional one-purpose equipment. In any case he grows adequate feedingstuffs for self-sufficiency.

Tractors, Horses and Labour There is still a place for the horse on this farm, partly because it is realized that it is still the cheapest and most effective way of doing jobs such as short distance carting, inter-row sugar beet cultivations, distributing fertilizers, haymaking and horse-raking, " jobs where a tractor looks silly," but also because there is on the farm one of " nature's gentlemen " who loves working horses.

There are three tractors, two wheeled and one tracklayer. The latter is regarded as being very valuable even on light land. One advantage is that it makes it possible to carry out earlier cultivations than would be possible

with wheeled tractors, and in this way the annual weeds are reduced. The object is to kill as many crops of weeds as possible before sowing. Spraying to control weeds is felt to be a valuable expedient in an emergency, but it in no way obviates the need for good cultivations at the right time ; good cultivations are cheaper and less risky than spraying. A spring-tine weeder is used extensively for controlling weeds in growing crops and is very effective, especially when it catches the weeds at an early stage. There is one combine harvester, but it is not used to any great extent ; preference is given to the traditional method of harvesting with a binder and putting the corn in stacks. This is still regarded as the cheapest and best method of storing grain, and it gives an opportunity of taking advantage of the market rises in price without having to put up expensive bins for storing the grain. The threshing machine, which was bought for £100 in 1914, is still working efficiently and deals adequately with the corn. The usual practice is to thresh some corn near each of the yards immediately after harvest and before starting sugar beet lifting. In this way it is possible to bring young stock into yards and have food and litter available without interfering with the operations of sugar beet harvesting.

There is a regular labour force of 14 men, and the general farm policy is to employ as many people as can be efficiently and economically used throughout the year, avoiding casual labour as far as possible. The only time when it is found necessary to employ such labour now is for the potato harvest. The work on the farm is all carefully planned and seasonal activities well dovetailed so that each job is completed at the right time without rush or bother. For example, some indications have already been given of the way in which threshing is carried out, and clover rubbing is done after Christmas, usually in early January. The most convenient time for potatoes to be riddled on the farm is during February. Fences, which are kept in a good condition, are maintained during January, February and March. One man is responsible for one yard of cattle and almost full time on hedge-laying. Ditches and drains are also attended to during the winter.

A small area of felled woodland (9 or 10 acres) was a constant source of trouble to arable crops by harbouring rabbits. The thick undergrowth of bushes and small trees was cleared and the whole field reseeded in 1950. The larger trees were left as a windbreak in the bottom of the valley.

More from Every Acre Whatever method is used for measuring the output from this farm, it is found to be of a high order. The cash value per acre was approximately £50, and whether expressed in output per acre, per unit of capital, per unit of machinery, per unit of manpower, or in terms of starch equivalent, it appears that the highest potential output has been reached and from the appearance of the farm it seems that this system of farming can go on indefinitely.

Mr. Hutchinson thinks that there is a great need for more intensive production on many farms. Too many people today, he says, look for more acres instead of trying to get more out of the acres they have. There are many advantages in farming today, but he considers it must be realized that to get more food per acre over a long period of time the maximum numbers of livestock must be carried on the land.

HIGH OUTPUT FROM SANDY LAND

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National Agricultural Advisory Service, Yorks and Lancs Province

Mr. Ibbotson farms over 700 acres in the Vale of York. His management concentrates on remedying the faults of this naturally poor land—mainly sand, with some peat. He has to contend with lime deficiency, blowing sand, deteriorating drainage, and rabbits. He sticks to the crops that grow the best, manures them generously and stocks the land as heavily as possible.

IN the Vale of York there is an extensive and important area of sandy arable land carrying a high proportion of root crops, potatoes, sugar beet and, where the soil is suitable, carrots. Here, on the eastern side of the Vale, bordered by the uplands of the Yorkshire Wolds, Mr. T. Ibbotson farms three farms (totalling 713 acres) which, except for 105 acres of peaty soil, are all sand, mainly overlying clay at varying depths. The output from these farms has been gradually increased over the years until it has now reached a high level.

In round figures 100 acres of potatoes, 100 acres of sugar beet, 220 acres of cereals and 25 acres of carrots are grown annually. There are 153 acres of leys and 105 acres of permanent grass, all the latter being on the peaty soil. Most of the income is derived from cash crops, but stock also make an important contribution whilst utilizing by-products and helping to maintain the fertility of the land. The stock consists of 60 cows rearing beef calves, 60 home-bred beef stores, 60 dairy cows with 33 followers, 170 sheep, 300 pigs and 600 head of poultry.

Mr. Ibbotson started farming in 1928 when he was twenty years old, and went through the bad times. He has sold potatoes for as little as 22s. a ton and carrots at 17s. 6d. a ton. He started on one of the three farms he still has, Stray Farm, Market Weighton, covering 114 acres. Part of the land is good sand but to the west and south-west the farm adjoins a heath and here the sand is so light that when Mr. Ibbotson first had it, it used to blow in high winds : seedling sugar beet and carrot crops were frequently blown out and had to be resown ; ditches filled with the blowing sand and digging them out added to the expense of farming this land. In its natural state this light sand was very acid and quickly lost any lime applied to it, so that to keep it sweet enough for cropping it had to be limed very frequently.

Marling to Prevent Blowing Mr. Ibbotson became very interested in the practice of marling, which had been carried out intensively in this area in the middle of the last century, but had subsequently been abandoned owing to the cost and the heavy labour involved. He experimented by marling 16 acres. When, later, the Ministry of Agriculture started an investigation in the East Riding during the war to discover the economic possibilities of marling with modern machinery, Mr. Ibbotson immediately co-operated and had this light blow-away sand marled. It was easy to do, for Keuper marl was available below the sand and was taken from a pit alongside the field. This Keuper marl is very friable, containing on the average about 28 per cent of clay. Applied at the rate of about 150 tons per acre, it stopped serious blowing, so that the risk of seedling crops of sugar beet and carrots being blown out was overcome. This not only obviated resowing but, of still greater moment, no time was lost in the

growing season, which meant that the crops were better and bigger. The ditches no longer quickly filled with sand and if one can judge from the results of marling done in the past, the lime status of the soil was assured for a long time ahead. Altogether, Mr. Ibbotson marled 170 acres.

More recently a cheaper method of mechanized marling (about £15 per acre) has been worked out commercially and put into practice. Mr. Ibbotson intends to marl a further 35 acres during the coming winter by this method. The reduction in cost is brought about through a saving in the spreading of the marl by tipping trailers which distribute the marl in a thin layer whilst moving slowly forward. This method greatly facilitates the use of machinery such as cultivators or rotovators to mix the marl with the soil.

Trace element deficiencies have given a little trouble in dry seasons on blow-away sand that has been marled, particularly boron deficiency in sugar beet. On this very light sand trace element deficiencies are easily induced by overliming. With this Keuper marl, which had 14–18 per cent carbonate of lime in the dry matter, a 150-ton dressing meant a heavy dressing of lime. Even buttressed as it is with clay, boron deficiency was very noticeable on sugar beet in the exceptionally dry season of 1949, but in spite of this, the beet yielded 14¼ tons per acre. In the wetter seasons of 1950 and 1951, the trouble was only very slight. On the whole, this is considered to be a relatively small disadvantage to set off against the advantages.

Arable Cropping *Sugar beet* and *potatoes* are very important root crops on these farms and a hundred acres of each are grown annually. The yield of sugar beet over a period of years has been 11¼ tons of washed beet per acre. The beet is usually grown after wheat. Farmyard manure not required for the potatoes is applied as far as it will go in November, together with 5 cwt. of salt, and the whole is then ploughed 12 inches deep. In spring, 15 cwt. per acre of No. 1 National Compound fertilizer is worked in a fortnight before sowing, the latter being started in the beginning of April and continued over the month to spread the work of singling.

With the aim of getting the seedbed firm and level, the original 12 inch ploughing is done round the field, starting in the middle so as to leave no furrows. The cultivation of the seedbed is very thorough, much of the work being carried out with a crawler tractor and spring-tined harrows. The last operation is to go over the field twice with the crawler drawing rollers, plus light seed harrows behind. The seedbed should then be even, solid and without a wheel-mark.

The seed is sown at the rate of 18 lb. per acre, using a four-row drill made up of four separate unit drills attached to a toolbar with a steerage fin. The latter is very important for the power hoeing which follows. The power hoe does the same four rows and consists of eight knives on the toolbar and a steerage fin. The steerage fin follows the original fin-mark. No steering gear is needed and no second man. All the power hoeing in the root cultivation is done by one man only on a tractor outfit. The tractor proceeds at speed on third gear. The tractor driver simply follows the previous tractor wheel-marks made when sowing. The knives are closed to leave only a strip of 1½ inches unhoed land around the seedlings. The advantages are that apart from only one man being required, faster travelling gets more work done in a day, and by going at speed the weeds are thrown right out on top and die quicker.

Potatoes. The land for potatoes is dunged and ploughed 12 inches deep, and 15–20 cwt. per acre of No. 1 National Compound fertilizer is applied on the flat before mechanical planting. About 30 acres are earlies (Home Guard and Arran Pilot) which in a normal year are lifted from the middle of July onwards. Most of the main crop is Majestic. New Scotch seed is used every year and the once-grown seed is sold. The aim is to get all the potatoes planted before the middle of April and at the latest before the end of that month. The average yield is 10–11 tons per acre.

Wheat and Rye. The potatoes are followed by winter wheat on the better sand and by rye on the poorer and lighter soils. From 2 to 2½ cwt. of a compound, consisting mainly of phosphate and potash, are sown with the seed by combine drill, and in March, if the crop looks poor, 1 cwt. per acre of " Nitro-Chalk " is applied. Then in mid-May, regardless of what the crop looks like, it gets another 1 cwt. per acre of " Nitro-Chalk". Most of the rye grown at present is the Danish variety *Petkus.*

Barley. Short-strawed types only, such as Freja, Kenia and Ymer, are grown. Mr. Ibbotson likes to get them combine-drilled in February or March with 12 stone of seed and 3–3½ cwt. per acre of No. 1 National Compound fertilizer. Last year 9 quarters per acre was obtained, but the average yield is about 7 quarters. All the barley is combine-harvested but only when very dry and ripe, so that it does not need to be dried artificially.

Carrots. About 25 acres are usually grown and the average yield is about 15 tons per acre. Small weeds are the biggest bugbear in carrot growing. During the last three years they were controlled successfully by spraying a six-inch strip over the carrot rows with tractor paraffin, using 25 gallons per acre. The carrots are grown on the lightest sand, where not only do they do well but their quality is excellent. Fertilizer at the rate of 15 cwt. per acre is applied, and sowing is delayed until the last week in May so as to reduce the risk of carrot fly. Lifting was done quite successfully last year with a sugar beet harvester.

The rotation of crops varies, but a seven-course is followed on most of the land. It consists of a three-year ley, followed by potatoes, then winter wheat, or rye on the very light sand not suitable for wheat, then sugar beet with a small acreage of carrots on the lighter land, and finally barley or oats or mixed corn, undersown with the long ley. This rotation was started shortly after Mr. Ibbotson had taken his second farm, South Farm, South Cliffe, in 1937. The farm was poor and swarming with rabbits, some of the arable land was semi-derelict and the grass poor and bad. In the process of grading up this farm, Mr. Ibbotson ploughed out some of the more worthless grass and cropped it. The results surprised and impressed him, so that he decided to introduce the ley into the rotation for his poorer sand. It provided, too, a longer rotation, which, in itself, was a safeguard against potato root eelworm and allowed a more self-contained stock policy.

Yarded Stock Dung is very important for this light land and, in making it, home-grown straw is supplemented with about 100 tons of bought straw each year. There used to be fattening bullocks in the yards to produce it, but now at one of the farms, South Farm, there is a milking herd of 60 attested Ayrshire cows accommodated in a yard and milking parlour at one of the farms. At another farm, Wholsea Grange Holme on Spalding Moor taken during the war in 1941, which includes 70 acres of low-lying peaty land growing relatively poor grass and not near any farm buildings, there is a herd of beef Shorthorn-type calving down in the spring to a Here-

ford bull. They suckle and rear one calf each. The cows come up to the straw-yards in the winter from Christmas onwards, but run out during the days and get straw with a little hay but no concentrated food. The calves from these cows go to the foldyards of the third farm, Stray Farm, in winter, from which they are usually sold the following spring. Last year the average price was £33 a head.

In the dairy herd the cows calve in the autumn ; sand land is not good for summer grass, so it is planned that the bulk of the cows are dry at this time. Kept in the foldyards in winter and milked in a " parlour," the milk yields are, perhaps, not as high as they would be if the cows were kept in a cowshed, but to offset this is the very important fact that more and better manure is obtained. Furthermore, there is a saving in labour ; only two men are required to look after, milk and feed the 60 cows.

Full use is made of all farm by-products. Sugar beet tops are utilized until January. Sugar beet pulp is used throughout the winter. All grass surplus to grazing needs is made into pit silage and any left over from one season are carried to the next. With the Cockle Park type mixtures used on this dry sand, the leys grow rapidly from May to June and slow down in July. To supplement the grazing in July the plan is to have an area of aftermath from a silage crop cut in May. After hay there would often be none.

Grass silage-making is mechanized and practically foolproof. Three men are sufficient for the job—one cutting, one on a tractor with a buckrake, and one at the pit. When the one cutting has cut enough, he helps to collect with a tractor and buckrake. A field pit 20 yards long, 4 yards wide and 4½ feet deep (capacity 100 tons) can be made on this sandy soil in one day by one man on a tractor with a scoop. The filling is carried up as high above ground level as can readily be done, and when completed sealed with soil immediately ; immediate covering is very important to eliminate waste. The soil is put directly on the grass without a straw covering first. The loss in material is negligible and when required for use it is very easy to pare the soil off the silage.

Besides the cattle there is a flying flock of hogg lambs, which last winter numbered 165. They live largely on by-products that otherwise would be wasted and consume the sugar beet tops not carted off for the cattle. These, with 300 pigs and 600 head of poultry, complete the stock.

To work these farms a permanent staff of 16 men and 3 girls is employed and additional casual labour is hired for singling, hoeing and lifting the root crops. Power on the land is supplied by nine wheeled tractors and one crawler. Other machines include a combine, a baler, a beet harvester, a muck-loader, muck-spreader, potato-planter, and full range of rowcrop equipment.

On these sandy farms stretching alongside woodland and moor, a close watch has to be kept on rabbits. Some are gassed and there are three miles of rabbit-proof fences.

Ditches and drains also need constant attention. The drain-pipes gradually fill with sand over a period of thirty or forty years, and if the ditches are not kept dug out the process is quicker. The ditches are cleared carefully every summer and the pipes lifted out and cleaned as necessary. Since 1936, 400 acres of drains have been attended to, but this is largely because the drainage on the two additional farms taken was in very bad condition.

CHEMICAL CAPONIZATION

THE USE OF SEX HORMONES FOR FATTENING COCKERELS

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Surgical caponization, to secure larger birds with soft flesh, is an ancient practice. The modern method relies on the administration of synthesized sex hormones and produces a tender bird of good appearance, acceptable to public demand.

THE capon, or surgically castrated bird, was at one time, notably in the late Tudor period, a well-known feature of the British table. The operation of caponization has been known for many centuries and was referred to by Cato and Varro as far back as 37 B.C. The practice has, however, steadily declined, particularly over the last thirty years, until today it is a rare occurrence in this country. But chemical caponization, which is strictly speaking a misnomer since the testes are not removed but are made to regress in size and activity, has gained a lot of ground in the past twelve or thirteen years, and it is pertinent, therefore, to review briefly the present position.

The capon of old owed its popularity to its greater tenderness and size, and to its plumper appearance. The traditional view was that the capon grew faster and so was better than the entire bird, but this is not quite accurate. It is true that if allowed to carry on growing the capon will produce a much bigger bird, but this is because the entire cockerel makes relatively little growth after it has attained sexual maturity, whereas the capon suffers no such check and continues for longer to grow at about the same rate.

The reason for decline in surgical caponization is undoubtedly partly due to the time and skill required to prepare and secure the bird and to carry out the operation with the minimum of "slips" (i.e., birds that are only partially castrated) and unsightly "wind-puffs" that have to be looked for and subsequently punctured. It is also necessary to starve the birds for at least twenty-four hours before the operation so that the intestines may be sufficiently empty to allow the operator to get at the testes easily : this is particularly important when it is desired to remove both testes through a single skin incision from one side only.

Another reason lies in the changing tastes of the public, which today prefers a younger and smaller bird for the table, and the surgical capon is not so desirable or economic for this purpose.

In essential, chemical caponization is the treatment of cockerels with oestrogens or female sex hormone-like substances to restrict or reduce their sexual activity. The oestrogens have only temporary effects and unless treatment is continued to a proper schedule the bird will return to the sexually active state. Endocrinologists have shown that a delicate balance of the hormones is maintained in the blood circulation of the normal animal or bird. Any excess of the hormones of either sex produced in the blood of the male bird will, by acting through the medium of the anterior pituitary gland, cause suppression (partial or complete according to the level of sex hormone prevailing) of the production of gonadotrophin and regression in size and activity of the testes. Following from this it was found that oestrogens administered to cockerels led to results superficially similar to those following surgical caponization.

Oestrogen Treatment The first effects of oestrogen treatment of cockerels will naturally depend on the age at which treatment is started, but generally speaking the birds will become less active, more docile, and they will cease to crow.

When treatment is started at 6 or 7 weeks of age, before the typical male comb and wattles are fully developed and the male call is not yet in evidence, these secondary sex characters will not develop. If treatment is not begun until the birds are older the comb and wattles will shrink and the typical male call will soon cease. Other secondary sex characters, such as the pointed feathers of the hackle and saddle and the sickles of the tail, are not affected by surgical caponization, and in the old days it was the custom to sell capons with their feathers on so that the customer could assure himself of the genuineness of his purchase. As the modern trend of the table poultry trade is towards younger birds and the sale of plucked carcasses, the chemical capon has to sell on its appearance in the plucked state, so that any feathering differentiation, if it occurs, is not of practical importance.

Two other important effects of oestrogen treatment are to increase the number and the size of the cells of the skin and to induce a degree of lipaemia, or level of fat in the blood. The former effect produces a smoothness, bloom and translucence of the skin, which does not follow surgical castration. The lipaemia produces a flesh that is younger looking and more tender and which remains juicy and does not dry out in cooking. This latter effect is due to the deposition of many minute particles of fat throughout the muscle fibres.

Whereas the surgical and the chemical capon both carry more fat than the entire cockerel, it has been found that the latter does not have the large subcutaneous fat deposits of the surgical capon, which gave the latter bird its superior appearance and cooking potential. The chemical capon, in addition to the bloom and smoothness of its skin, is singularly free from prominent feather follicles, another effect that does not follow surgical castration.

The cost of oestrogen treatment varies between 4d. and 1s. per bird, according to the method employed. With a free market dealing in the main with the small table bird, improved appearance and cooking qualities will normally earn sufficient premium per pound to make the treatment worth while. Under a system of price control whereby all poultry meat is sold at a fixed price per pound, chemical caponization will be justified economically only if it results in an improved rate of weight gain and in greater efficiency of food utilization.

There exists an impressive volume of published evidence on the effects of oestrogen treatment on these two aspects, which is too great to be critically reviewed in an article of this length. It must, therefore, be sufficient to say that in the U.S.A. and in this country there is considerable conflict between the results and it is evident that factors other than just the treatment are involved. Two papers suggest that the diet of the treated birds plays an important part in the results obtained in any trial. Bird (1948) showed that when oestrogen was administered to two groups of birds, one on a 14 per cent protein diet and the other on an 18 per cent protein diet, the improvements in rate of gain in weight and in efficiency of food conversion compared with an untreated control group were greater on the lower protein diet. Earlier Thayer and Gross (1946) had shown that, when fed as the sole grain in a diet at the rate of 50 per cent to broilers receiving dianisyl hexene at 50 mg. per lb. of diet, Kafir, maize and wheat were superior to oats and barley. These observations suggest that, until more is known of the ideal

diet, it is unwise to be dogmatic about the probable economic returns to the general poultry industry. Among the good results claimed are those of Black and Bennett (1951), who fed their birds on a diet largely made up of home-grown feedingstuffs.

The breed type of the bird is another important factor. The general trend of opinion is that the heavier breeds, such as Rhode Island Red, Light Sussex and Plymouth Rock, and their crosses are more suitable for oestrogen treatment than the Mediterranean breeds, such as Leghorn, Minorca and Ancona. The latter may, however, find a place in the structure of the British table poultry trade.

The Synthetic Oestrogens Synthetic oestrogens are chemical compounds that exert the same physiological effects as the naturally produced female sex hormones. Those most commonly used in the U.S.A. and in this country are as follows :

Common Name	Simple Chemical Name
Stilboestrol	Diethyl stilboestrol
Dianisyl hexene	Dimethyl ether of stilboestrol
Dienoestrol	
Dianisyl hexadiene	Dimethyl ether of dienoestrol
Hexoestrol	
Dianisyl hexane	Dimethyl ether of hexoestrol
Oestradiol	

These compounds vary in their degree of effectiveness, while some are more effective when given orally than subcutaneously, and others are more effective subcutaneously. Oestradiol is most commonly used by the intramuscular route.

Stilboestrol is the one that has so far been most used in this country, and it is far more effective when given subcutaneously. It was first synthesized in this country (Dodds, Golberg, Lawson and Robinson, 1938). Lorenz (1945) showed that a single subcutaneous implant of 8 mg. of stilboestrol was more effective than 140 mg. of the same oestrogen given in the food over a period of a month or so. It would appear from the work of Munro and Kosin (1946) that as far as stimulation of growth of the oviduct in pullets is concerned, the greater the degree of saturation of the alipathic block of the molecule and the higher the methylation of the side chains, the greater is the efficiency of an oestrogen when given in the food. Their work showed that when incorporated in the diet at 30 mg. per pound the descending order of potency was dianisyl hexane, dianisyl hexene, hexoestrol, dienoestrol, dianisyl hexadiene, and stilboestrol. Further comparative data for different oestrogens administered by different routes were given by Bird (1948) on the basis of their RD_{50}, i.e., the weight of the substance (in grams) required to produce oestrus response in 50 per cent of spayed female rats. The higher the efficiency the lower will be the RD_{50}. Bird's data, some of which are given below, show that stilboestrol and dienoestrol are more effective subcutaneously, while dianisyl hexene and dianisyl hexadiene are more effective if given in the diet.

	RD_{50} by Different Routes	
	Subcutaneous	In the food
Stilboestrol	0.32	2.02
Dianisyl hexene	13.40	5.70
Dienoestrol	2.11	6.73
Dianisyl hexadiene	27.30	20.50

None of the above work was carried out with cockerels, and the evidence in respect of variability in efficiency as far as chemical caponization is concerned is presumptive. In a recent paper Black and Bennett (1951) have compared groups of twenty-five birds treated respectively with single 15 mg. implants of either stilboestrol or hexoestrol at 9 weeks old with similar untreated Brown Leghorn × Light Sussex cockerels : some of their data on the birds at 20 weeks old, or eleven weeks after treatment, are shown below :

Group	Survivors	Weights at 20 weeks old				Gain per cwt. of food
		Average				
		lb.	*oz.*	*lb.* *oz.*	*lb.* *oz.*	
Control	24	5	14	(4 6 to	6 9)	14.5 lb.
Stilboestrol	25	5	14	(5 0 to	6 7)	15.7 lb.
Hexoestrol	24	6	5½	(4 15 to	7 8)	17.6 lb.

From these data it appears that on their diet, which was composed mainly of home-grown foods (details not given), hexoestrol exerts its influence more powerfully and for a longer period than stilboestrol ; this is further emphasized by the higher proportion of birds showing definitely feminine combs and wattles at eleven and thirteen weeks after treatment.

Methods of Oestrogen Administration The oestrogen treatment of cockerels may be carried out in one of four ways :

(*a*) subcutaneous implantation of pellets or tablets ;
(*b*) intramuscular injection of solutions ;
(*c*) oral administration by incorporation in the food ;
(*d*) any of the above methods combined with the addition of thiouracil in the food.

Implantation. Pellet implantation is the method most commonly used in this country today, chiefly because it is easy and relatively cheap. It consists of inserting a pellet or tablet containing a known amount of oestrogen (usually 15 or 30 mg.) under the skin but not in the connective tissue. This technique was originated in Britain (Deansley and Parkes, 1937).

Implantation may be in one of two ways, depending largely on the number of birds to be treated and on the poultry-keeper's preference. A special injector, working on the principle of the hypodermic syringe, may be employed. In this case the needle is inserted through a pinched-up fold of skin at the base of the skull in the median dorsal line of the neck, and its point made to travel ¼ to ½ inch along under the skin in a downward direction before the plunger is operated and the pellet left *in situ* when the needle is withdrawn. Injectors may require single pellet loading or they may be fitted with a form of magazine holding a number of pellets. The other method, when few birds are to be treated, consists of making a small incision in the skin at the same spot as the injector should be inserted, using a scalpel or sharp knife, and pushing the pellet along under the skin with a fine pair of forceps. The object of making the implant as far up the neck as possible is to make it easier to ensure that any unabsorbed residue of the implant is discarded when the bird is prepared for human consumption.

With stilboestrol, the implant remains effective only for six or eight weeks, and it is customary to implant six weeks before the bird is to be killed, or if necessary with older birds to implant twice—at twelve and six weeks before killing. Thus a bird to be killed at fourteen weeks would be implanted at

8 weeks old, while one to be killed at twenty-four weeks should be implanted twice, namely at 12 and 18 weeks of age. The work of Black and Bennett (1951) indicates that hexoestrol may exert its effect for a longer period than does stilboestrol.

Injection. Solutions of compounds of oestradiol are usually injected into the muscles of the thigh or into the wattles. The needle for either site of injection should be of very fine gauge and the syringe should be of the type fitted with a controllable stop on the plunger so that there is less risk of overdosage if the bird struggles during the injection. The solutions should be kept in dark glass bottles and in the dark, as they soon lose strength in strong light ; but it is not necessary to keep them in a refrigerator or other cold storage.

Oral Administration The inclusion of oestrogens in the food of the birds eliminates the work of catching and treating each bird individually which is inherent in the foregoing methods, but it has drawbacks of its own. The amount of oestrogen to be incorporated in the diet is very small and this entails very thorough pre-mixing and mixing to ensure even distribution so that all birds get the same level of oestrogen in their intake. Even when the mixing is 100 per cent perfect, the birds do not get a standard dose, as the amount they take depends on appetite. Finally, the method entails the use of a great deal more oestrogen, so adding to the cost of treatment.

Oral treatment should normally be given for a period of eight weeks and be omitted for two weeks before killing. This means that it should be started ten weeks before it is intended to slaughter the birds.

Combined Oestrogen and Thiouracil Treatment. Thiouracil is a chemical compound that assists fattening by depressing the rate of secretion of thyroxine by the thyroid gland, so reducing the general rate of the animal's metabolism. If used in moderation and under suitable conditions, it leads to improvement in fat deposition and in the market grade of the carcass. Thiouracil should never be fed to chickens under 9 weeks old, otherwise it will lead to reduction of body size and to loss of stamina. Nor should it be fed to birds for longer than four weeks since after that time it leads to a decrease in the rate of gain and in the efficiency of food utilization.

Fortunately there is no physiological antagonism between thiouracil and oestrogens, and practical tests as well as controlled experiments have shown that simultaneous treatment with both substances can give excellent results in respect of rate of weight increase and in the efficiency of food conversion.

Irrespective of the method adopted for oestrogen administration, the thiouracil should be thoroughly mixed in the food at the rate of 0.1 or 0.2 per cent over the last three or four weeks of the fattening period.

Dangers of Oestrogenic Substances Since oestrogenic substances exert their secondary sex effects on all species, including the human race, it is imperative to make sure they are not left about so that they can be got at and taken by children or inquisitive adults. *Keep them under lock and key.*

Thayer, Jaap and Penquite (1945) showed that excess oestrogen administered to birds can produce serious interference with normal bone metabolism, leading to brittleness and deformities of the skeleton. It is important,

therefore, not to exceed the dose recommended by the makers of the different preparations, since to do so is to introduce a hazard to the health of the birds as well as to waste money since the excess oestrogen produces no further beneficial effect.

Some of the orally active oestrogens are retained in the tissues of the bird, principally in the liver, and are active even after cooking. Bird, Pugsley and Klotz (1947) showed that heavy consumption of such livers could produce disturbances of the menstrual cycle even in post-menopausal women. It is accepted in this country that this risk is very slight in view of the relatively large consumption of chicken livers needed to cause these symptoms, and that the implantation of stilboestrol and hexoestrol is entirely safe from this aspect.

When implanted birds are prepared for the table it is essential to make sure that the unabsorbed residues of the pellet are not left in the carcass for cooking. Whoever does the dressing should be informed that implantation was done and be warned to look carefully to see that the implant residue is discarded.

Where poultry waste including heads and necks is used for the feeding of animals it is important that the site of the implant should be carefully examined and all trace of residues removed. If this is not done there is a grave risk that the unabsorbed portions may cause serious effects among the animals. There have been cases in the U.S.A. where failure to pay sufficient attention to this has led to outbreaks of abortion on mink and fox fur farms. It is easy to see that when this occurs the farmer loses the whole of his pelt crop for the season. The seller and purchaser of offal from chemical capons should take all precautions to eliminate this sort of disaster, though the onus is more squarely on the purchaser.

There are no legal restrictions on the sale of oestrogens in the United Kingdom, except in Northern Ireland, where, under the Medicines, Pharmacy and Poisons Act (Northern Ireland) 1945, oestrogenic substances, natural or synthetic, can be sold retail only on the prescription of a doctor or a veterinary surgeon. Theoretically, therefore, with this exception oestrogens could be bought without restrictions from any pharmaceutical chemist, but in practice it will be found necessary to get a prescription from a doctor or a veterinary surgeon for the purchase of certain brands of oestrogen. This is a safeguard imposed by the makers to reduce the risk of misuse of their products. Intending purchasers should find out what brands are available and whether or not a prescription is needed.

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POTATO ROOT EELWORM UNDER GLASS IN SOMERSET

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This Somerset survey over 1948-50 shows the degree of tomato glasshouse infestation by potato root eelworm to be serious. This is true of other parts of the country too. The use of D.D. as a fumigant control is not advocated.

THE presence of potato root eelworm under glass in Somerset has been known for many years, but in 1948 it was decided to undertake a survey of glasshouse holdings in the county, to find out to what extent this eelworm could be regarded as an obstacle to increased tomato yields. The survey was started during the winter months of 1948-49, when 51 holdings were visited, and continued in 1949-50, when 54 other nurseries were included.

The eelworm population of an infested soil is continually changing, more especially so under glasshouse conditions. The larger growers frequently steam sterilize ; the smaller ones sometimes change their glasshouse soil. Growers in the medium range, however, find neither of these methods easy ; and it is on that size of holding that potato root eelworm is most likely to build up to serious levels, since it is here that tomatoes are grown year after year in the same soil without any treatment. It was felt therefore that, since the survey could not be complete, it would be most helpful to choose growers mainly in the medium range.

Soil samples were taken to a depth of 8 inches after the tomatoes were cleared and the houses empty. Sampling early in the survey was by soil auger, but it was soon found that a much more thorough sampling was possible without loss of time by using a root-sampling iron ; three to four times the number of individual samples were taken without adding to the final bulk of soil to be examined. The samples (bulked from each house) were air dried in the laboratory, sieved, coned and quartered, and the cysts extracted from a known weight (usually 50 grm.) by flotation. The recovered cysts were opened and examined for viability.

Results of Survey In Table 1 the number of nurseries is given where the greatest infestation present is at the level indicated, the categories ½–1 etc. referring to " viable cysts per gram". The total number of individual glasshouses sampled is also divided in the same manner in Table 2 on page 392.

Table 1. Nurseries

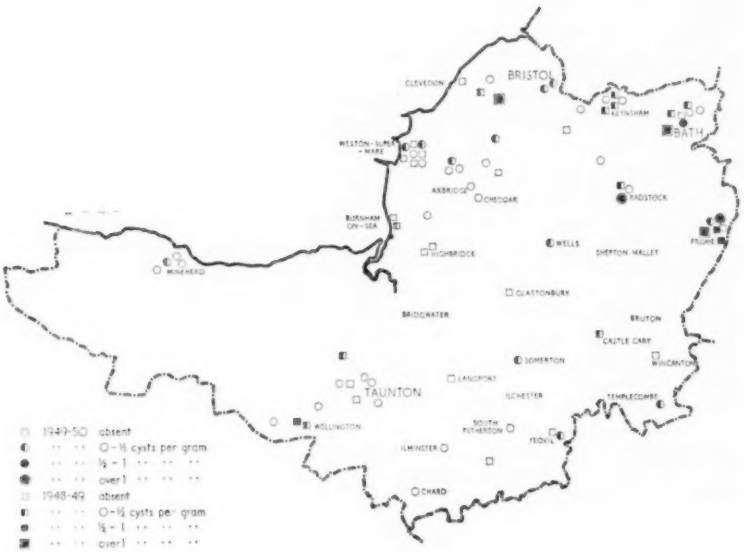
Populations (viable cysts/gram)	Absent	0—½	½—1	>1	Totals	% Present
1948—49	19	12	6	1	38	50
1949—50	28	12	1	2	43	35
Total	47	24	7	3	81	42.5

Table 2. Glasshouses

Populations (viable cysts/gram)	Absent	0—½	½—1	>1	Totals	% Present
1948—49	38	19	8	3	68	44
1949—50	52	18	1	2	73	29
Total	90	37	9	5	141	36.5

If the usual threshold of ½ cyst per gram is used, it may be inferred from Table 1 that in approximately one nursery in eight potato root eelworm is a factor limiting yield ; one glasshouse out of every ten sampled has a population likely to affect plant performance. Unless steps are taken to keep the populations in check, the future outlook is serious.

The map below shows the distribution of the infestations. It may be mentioned that several nurseries in the Frome area are badly infested ; those sampled in the Taunton area are substantially free of the pest.



The Use of D.D. To combat the pest a number of growers in Somerset have for several years been using D.D.* Extensive field trials in other districts with this material against potato root eelworm (as a pest of potatoes) have not given promising results (1) : although yields were increased, the populations present in the soil after the crops were grown had also risen.

Under glasshouse conditions, one might expect a greater control in warmer soil through better distribution of the fumigant. In the West Midland Province in 1947, the writer found some evidence of a retarded rate of build-up of populations subjected to D.D. treatment, compared with untreated populations. (In press). During the Somerset survey an attempt has been made to compare the total populations present in heavily infested soils, treated with D.D., before and after the production of the 1950 tomato crop. If control by this means is to be effective, there should at least be no great increase in total population present. A further criterion was used here ; egg populations from recovered cysts were estimated by aliquot methods. Three quantities are then readily estimated, namely cysts per gram (C/G), eggs per gram (E/G), and eggs per cyst (E/C). Table 3 shows these quantities before and after the production of the 1950 crop, and their ratios, for glasshouses in three heavily infested nurseries in the Frome area.

The figures are subject to sampling and laboratory errors, but since the number of samples taken was large, and the infestations high and fairly uniform, these errors are not likely to be big, and will be less in the higher counts (2).

It appears that D.D. has failed to prevent a considerable increase in the total populations present. On the average, the production of a crop has approximately trebled the cyst and egg populations in the seven glasshouses sampled.

Table 3

Populations before and after the 1950 crop. Soil treated with D.D.

Nursery	House	March, 1950 (a)			October, 1950 (b)			Ratio (b) / (a)			Remarks
		C/G	E/G	E/C	C/G	E/G	E/C	C/G	E/G	E/C	
1	A	1.84	272	148	3.36	407	121	1.83	1.5	0.82	D.D. used 1949, and 1950
	B	0.82	85	104	1.50	184	123	1.85	2.17	1.18	D.D. used 1948, 1949, 1950
	C	0.16	26	161	1.54	180	114	9.6	4.4	0.78	D.D. used 1948, 1949, 1950
2	A	0.46	44	96	2.68	415	155	5.6	9.45	1.61	Steam 1946, D.D. 1950
	B	0.64	76	119	1.96	357	182	3.07	4.7	1.53	D.D. 1950
3	A	0.3	27	90	1.96	244	125	6.53	9.04	1.39	D.D. 1950. Same variety grown for some years
	B	0.5	26	52	0.7	81	116	1.4	3.1	2.23	D.D. 1950. Different varieties grown
	Means	0.67	79	118	1.96	267	136	2.93	3.38	1.15	

* A mixture of dichlorpropane and dichlorpropylene.

Over a *short* period there is little doubt that the use of D.D. results in greater yields, due to its marked "soil-amendment" effect. But this presents greater opportunities for the surviving population.

The laboratory work in connection with the Somerset survey was carried out in the Entomology Department of the S.W. Provincial Centre, N.A.A.S., Bristol. The writer is grateful to the Advisory Entomologist, Mr. L. N. Staniland, and to other members of the Department for help in various ways. The map on page 392 was kindly prepared by Mrs. S. Wadsworth. Thanks are due to Mr. Forshaw, Chief Horticultural Advisory Officer, Somerset, and his staff for their wholehearted co-operation.

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FARMING AFFAIRS

Corn Harvest The average annual rainfall in my district (on the Herts-Bucks border) is low—around 20 inches—and late summer is usually dry. As a rule, about four weeks are sufficient to secure my crop in good condition using the self-binder. The last two harvests have been wet and the work has dragged on for about seven weeks—from July 26 to September 18 in 1950, and from August 8 to September 20 in 1951. The weather was generally driest at weekends and in the evenings, consequently there was much overtime. In 1950 some time was lost by opening-out with scythes. In 1951 this old practice was dispensed with. A quicker and cleaner job was done by cutting back the outside swath with the binder fitted with lifting fingers—simple attachments used throughout to facilitate cutting around the field when corn was laid. Although in 1951 harvesting was interrupted by rain practically every other day, and often for several days in succession the crop suffered less damage than in 1950. In both years we stooked immediately behind the binder and made a point of setting up fallen sheaves, even shifting outside rows, but we did not escape some sprouting in 1950. In fact, that harvest was completed by building the sheaves of outside rows from several fields on and around a large central rack. This year we escaped all sprouting and were able to dispense with the rack. Oat and barley stooks and some also of wheat had to be turned over before carting, but because of exceptionally quick changes in the weather, it was never safe to turn far ahead of the trolleys.

As everywhere, seed-time was late, both in the autumn of 1950 and the spring of 1951. By the end of October we had drilled winter oats and one field of wheat. A second field of winter wheat was drilled in good tilth on January 22, 1951. All of these crops proved satisfactory. No further drilling was possible until mid-April when Atle spring wheat, barley and dredge corn were sown. Atle went into a rough seedbed after old pasture ploughed up. Owing to the weather and the lateness of the season, cultivations on part of a 23-acre field were rather scamped. Wireworm damage on this portion was soon evident and we patched with BHC-dressed barley.

This grew well, unchecked, and but for some support from a thin plant of the stiff-strawed wheat would have been badly lodged by harvest. The dredge corn referred to earlier consisted of oats and peas intended for feeding in the sheaf to outwintering cattle. For this purpose a fine-strawed oat is desirable and I had retained seed of Grey Winters for sowing in February or March. It was not possible, however, to sow until April 16. For a long time it seemed that the oats would never shoot into ear. Ultimately, ears appeared—first irregularly and then after with a rush, and a level crop, nearly but not quite ripe, was cut on September 3. I had undersown with clover and ryegrass for a one-year ley and have thereby secured what looks like very palatable fodder.

For mixed farms around 200 acres the tractor-binder method of harvesting, considering all things, seems to compare not unfavourably with the combine. For farms of this acreage specializing in cash cropping with few or no livestock, the case may be different. Comparative economic data would be useful. With the binder method it is a great advantage, nowadays, to have plenty of Dutch barns and one's own thresher. Seed for next year's crop is needed immediately after harvest for own use or for sale, also for thatching stacks in the field and for clamps. Straw is required for fodder throughout the winter, and the fresher it is the better. It is worth more than combined straw for sale. The quality of the grain harvested by binder is often superior to that combined, partly because of a wider choice of varieties. The combine undoubtedly saves labour and, in a favourable season, would shorten the harvest period. In a year like 1951, combining was often restricted to a few hours in the afternoon or evening, and owing to heavy dews it was sometimes possible to be carting sheaves while the combine was waiting for the corn to dry.

On the larger farms of typical corn-growing regions the combine is now firmly and successfully established. More information, however, is needed regarding the acreage that will justify the capital expenditure involved and the part, if any, which the combine can play in areas better suited to grass than to arable.

J. G. Stewart

Farming Cameo : 13. The Isle of Wight From an agricultural point of view, the Isle of Wight is divided into two distinct areas by the central chalk ridge, which is the backbone of the Island and runs from Bembridge in the east to The Needles in the west. In the north are found the heavier and sticky soils, mainly clays with an admixture of gravel ; these are difficult to cultivate but, under good management, make excellent dairy land. The soil types are mainly Hamstead Beds with some Bembridge marl and pockets of plateau and marine gravel. Much of this land overlies London clay which is known locally as " slipper clay". The terrain is fairly flat, varying between 45 feet and 150 feet above sea level, and on this type of land dairying is the rule, with the odd field or so under roots and dredge corn. Even on this sticky land it is the rule for dairies to lie out during the winter, and there is the inevitable poaching of the exercise fields during the wet season. The annual Island rainfall in normal years is in the region of 28 inches but pastures on these soils heal rapidly in the spring.

Along the top of the backbone is found typical chalk turf growing on a shallow soil, but there are also large areas of angular flint gravel deposits and where these occur the land is very acid. Much of this land is too steep

for normal Island farming and is being planted by the Forestry Commission ; the flatter area, which is relatively small, is devoted to arable crops or to grass for rearing horned stock.

South of the backbone is fertile arable land, most of it free-working soils derived from Lower Greensand, Sandrock Beds and ferruginous sands. Here market-garden crops, especially early potatoes, are largely grown and the Island growers can compete very favourably with Cornwall and the Channel Isles. Much of the soil in this area is very acid, and heavy dressings of lump or ground chalk are part of the normal farm management.

Immediately below the backbone the terrain is broken with steep slopes, and varies between 120 feet and 350 feet above sea level, while at the lower levels there are wet pastures, known as moors, where drainage is difficult and neglected ditches have produced rushes, iris and reed in large patches. They form good grazing land for beef cattle during the summer, and dairies yield well from this apparently poor pasturage.

The main market-garden area in the Arreton Valley extends south and west until it joins with the Atherfield Plain, where ferruginous sands associated with gault clay form fertile arable land. Here corn growing, with dairying and a fair number of sheep, is the rule. Dorset Horns are the favourite breed and, as is usual with this breed, lambing is in October or early November. This arable belt extends westward, crosses the backbone at Chessell and then west again parallel to the backbone, with Yarmouth on the north-west flank. In this area the soils are a mixture of limestone, ferruginous sands and Bembridge marls.

Generally speaking, most of the ploughable grass, even north of the backbone, has been ploughed, and ley farming is becoming more popular on those soils, where it is possible, but it is surprising how many farmers still cling to the old Norfolk rotation.

Breeds of cattle are varied as may be expected, but Guernseys are the favourite with Shorthorns second, while Ayrshires are becoming more and more popular. Since 1939 the dairy cow population has remained nearly static but the average milk sales per cow have increased by more than 50 per cent.

Attestation is progressing rapidly and to date 45 per cent of the herds are either attested or supervised. This is all the more creditable when it is remembered that approximately 56 per cent of the farms are between 5 and 100 acres, and a further 17 per cent are of medium size—between 100 and 250 acres.

Pigs are steadily increasing in numbers and have more than doubled in the last two years, but they need to double again to reach the 1939 figure. Poultry flocks fluctuate considerably during the year; often one-eighth of the birds are killed off during the summer season.

The reputation of the Island as a summer and seaside resort has had a very direct influence on its inherited farming policy. Between the wars, the summer influx of visitors demanded butter and rich cream, hence the preference for the Guernsey breed, and catering for these visitors resulted in plenty of swill being available during the holiday period. This, fed with the butter milk and skim milk, provided food for a relatively high pig population. The swill supply is still plentiful in the holiday season, and now that fodder beet has been introduced, there are good grounds for hoping that the pig population may become more stable throughout the year.

J. J. S. Webster,
Assistant County Agricultural Officer

Chains in Farming Equipment Chains have always been an important part of farm equipment, and for centuries cart and plough traces, hame and breaching chains, and cow tie-ups were made and repaired by village blacksmiths. When implements used in the field came to need a means of transmitting power, it was natural that the inventors should turn to chains, and the kind of transmission chain having detachable malleable square links was designed in 1880 specially for agricultural machines, though it is now used with other machinery. Its first use was as a drive-chain for reaper-binders, and it was found to be admirably suited to slow-speed transmission of power.

Malleable square links are easily detachable, and yet the chain cannot become accidentally split while it is on the sprockets, for each link has a curved tongue which wraps more than half way round the side-bar of the link on which it hooks. Thus one link can be fitted into the next merely by being pushed in from the side. When the link is connected it can be straightened into line with its neighbour, since the tongue, which protrudes between the bars and keeps the links interlocked while the chain is on the sprockets, is slightly narrower than the width of the inside of the square frame. To ensure that the links remain interlocked, the open slot in the tongue of each must face away from the sprocket wheel, and the hook-ends should face the direction of travel. The links may be detached by bending back the chain in the opposite curve to the one it takes when travelling round the sprockets. Chains of this kind are now made also in pressed steel, but in this case the tongue of each link is more tightly closed, and has to be sprung open when the side-bar of the next link is pushed through it.

Chains used as elevators, for example, hay elevators and manure spreaders, have special links, with slats or other attachments fitted.

Roller chains are suitable for much higher speeds than square chains ; they have a hardened steel sleeve fitted over each pin to form a rolling bush which provides the surface making contact with the teeth of the sprocket.

When transmission chains become worn the hinge part of the link becomes loose and so the chain stretches and may eventually come off the sprocket. The effects of this wear cannot be overcome by tightening the run of the chain which will still try to ride off the teeth, and will pull the sprockets towards each other with a strain that may break the chain or bend one of the shafts on which the sprockets are mounted. Some transmission chains run in enclosed gear cases and have a long life provided they are kept well lubricated. Others have to run in soil dust ; and these should occasionally be taken off, washed in paraffin and greased. Then the excess grease should be wiped off the outside before they are re-fitted.

Most tow chains, as well as transmission chains, are now made in large works, and hand welding of the links is often replaced by electrical welding, but the repairing of chains and the adaptation of lengths to special purposes can still be done at the local blacksmith's or on the farm itself. If welding of the links hot on the anvil is beyond the capacity of the farm workshop, mending-links, which need no heat for the join, can be used ; only cold riveting is necessary to make a sound connection.

Time is always well spent in looking occasionally at the farm tow chains and replacing any links that seem to be wearing before the others. It often happens that a chain has been subjected to more movement in two or three of its links than it has throughout the rest of its length, and the life of the whole chain will be lengthened if these worn links are replaced. Safety, as

well as convenience, may depend on chains being kept in sound condition. This is particularly true of trace chains and bull tie-ups.

Trace and other harness chains and cow ties, are very liable to rust, which can make them awkward to handle and inefficient in use. For example, a rusty ridge-chain on a cart saddle will not run smoothly in the groove ; it will bind against the sides of the groove so that the saddle will tend to move with the chain and chafe the horse's back. The rusting of chains can be prevented by drawing them through an oily rag from time to time.

H. J. Hine

The Texel Sheep The Netherlands has one indigenous breed of sheep, the Texel sheep which originates from the island of Texel. During the last half of the nineteenth and beginning of this century, a variety of English breeding stock was imported to improve the native breeds of sheep. Good results have been achieved by crossing them with breeding stock of long- and shortwool English breeds, and particularly with Lincolns and various Down sheep. These crosses were bred also on the island of Texel, where sheep breeding has always been an intensive line of farming (2 to 4 sheep per acre). It is difficult to establish now how far the crosses have affected the present stock, but a new breed that in many respects surpasses the cross-breds and the original English pedigree breeds, has been formed. Today, this new Texel sheep, being a mutton-wool breed, has displaced all other Dutch and cross-breeds ; the meat produced is of prime importance, with wool a secondary consideration.

The Texel sheep enjoys excellent health and is very hardy against unfavourable conditions of weather and nutrition. It is a strong and frugal animal, adapting itself easily to different climates and soils, so that it is suitable for export to other countries. In the Netherlands, sheep are always outwintered, and this also applies to Texel even with its harsh climate.

The breed is prolific ; twins are the rule at the age of two or over, and single lambs are an exception. Under favourable conditions a ewe can be tupped when six months old and at one year usually delivers a single lamb. With suitable feeding, the lambs grow quickly, and the Texel is therefore an *early maturing* breed.

The quality of the flesh is excellent. Shearling ewes, 1½ years old and ready for slaughter may weigh up to 220 lb., and at the age of 2 years, approximately 275 lb. A carcass, i.e., after the fleece, skin, head, legs and guts have been removed, will weigh 55–60 per cent of the live weight.

As a producer of wool, the Texel breed is characterized by long wool of true fineness such as that of the English finewool breeds, and a feature of it is its great strength. As regards the weight of the fleece, this sheep is intermediate between the English shortwool and longwool breeds. With rams and ewes of 1½ years of age, fleece weights of 13–17 lb. and 11–13 lb. respectively are no exception.

More Milk by Vaccination against Contagious Abortion During the last few years, there has been a steady increase in the average yield of milk per cow in Great Britain. Several factors have helped to bring this about but there is no doubt that the protection of dairy animals against contagious abortion, by vaccination with S. 19 vaccine has played an important part.

The Ministry of Agriculture and Fisheries operates a Calf Vaccination Scheme to help farmers take advantage of this method of immunizing their animals against contagious abortion at the most important time, namely,

from four months old up to the time of first service. The charge for vaccination under the scheme is only 2s. an animal. It has been estimated that during the lactation following abortion the loss of milk is of the order of 25 per cent. This represents a serious blow to the farmer, apart from the loss of the calf. Two shillings per animal is a small amount to pay for protection against the risk of such set-backs.

Farmers, particularly dairy farmers, who have had heifer calves vaccinated under the scheme are strongly advised to go on with vaccination, and to make sure that all heifer calves and maiden heifers up to the time of first service are presented for vaccination.

Newcomers can join the scheme at any time. Just send a postcard to the Ministry's Divisional Veterinary Officer, telling him that you wish to join and stating the name of your veterinary surgeon.

BOOK REVIEWS

Long Ashton Research Station Annual Report, 1950. 14s.

The present-day need to keep growers informed of progress in fruit and vegetable research is reflected in a reference in this report to the setting up of a technical information section at the Station. This section should undoubtedly help to bring the practical implications of the work at Long Ashton, and perhaps that elsewhere, more quickly to the attention of both horticultural advisers and growers. A further link with advisory horticultural work is being formed by the Station's collaboration with the N.A.A.S. Horticulture Experimental Stations, in the carrying out of joint field trials and by help given in providing the new stations with planting material from the Long Ashton orchards.

The report covers a considerable range of growers' problems. The progress of apple tree pruning experiments, first reported in 1937, is reviewed. Any pruning is found to reduce yield, but with winter pruning this is offset by a gain in quality. Pruning in summer as well as in winter reduces yield still more but without further gain in the quality of the fruit. Allington and Cox ultimately gave bigger crops when pruned as modified leader trees, but Worcester cropped better as an open centre tree. An interesting method is described for controlling pollination in fruit trees without the use of paper or muslin bags. The flower stigmas are smeared with a vaseline-olive oil mixture. This method has a number of advantages and, in spite of its tendency to reduce fruit set, is considered worthy of further trial.

Results for 1946–50 in the long-term nitrogen manurial experiments with black currants indicate that Mendip Cross has a higher nitrogen requirement than Cotswold Cross. It is pointed out that since a perennial like the black currant increases in size and cropping capacity each year up to a maximum, growers might well give smaller nitrogen dressings to young bushes, and increase the application each year, so as to maintain a suitable nitrogen status throughout the life of the bush.

Experiments have shown that supplying lime or molybdenum to the soil is an effective control measure against Whiptail in cauliflower, which is due to the lack of the trace element, molybdenum. Plants receiving molybdenum in the seedbed before planting out gave yields equal to those supplied with molybdenum in the field. Other sections of the report include those which deal with sand culture and field experiments on the iron metabolism of sugar beet and potato plants, the control of Apple and Pear Scab, methods of fruit bottling, and investigations on insect pests of fruit. In attempts to control the leaf-curling plum aphid with DDT–benzol emulsion, complete control was achieved by spraying at bud-burst, whereas spraying after the blossoming stage, when the leaves had already curled, was without effect. There is also an interesting account of an experimental "air-flow," small-volume sprayer and duster of the Station's own design.

The investigations on cider and fruit juices, with which the Station has long been associated, are described in a series of five papers which deal mainly with the processing aspects of cider-making. Copies of the report are obtainable from the Secretary, Long Ashton Research Station, Bristol.

A.J.L.L.

Great Farmers (2nd Edition). J. A. SCOTT WATSON and MAY ELLIOTT-HOBBS. Faber. 21s.

The cynic will tell you that we learn from history that men never learn anything from history. In truth, the lessons are there but they are apt to be overlooked or forgotten. Problems not unlike those of the present day confronted farmers of the period under review. If the industry is to learn from its own experience knowledge of how our forefathers succeeded and failed must surely be all to the good. Here in most readable form are biographical sketches of notable pioneers, from Jethro Tull to F. P. Chamberlain, whose enterprise and initiative are a timely example and inspiration in our present straits. The advance of agriculture has always depended on the originality and ingenuity of the few. Reinforced by the researches of modern scientists and engineers and a progressive spirit in the many, its pace should be greatly accelerated. Evolution, of course, does not beget uniformity. British agriculture is highly complex and infinitely differentiated, sorted out to accord with soil and climate and human predilection, yet, withal, it is an ordered society wherein every form of husbandry complements the others. Hence we find plough-men and pastoralists, intensive and extensive farmers, operating practically side by side. Pioneers in every aspect have arisen from time to time throughout the ages but the " simple purpose of this book," in the author's words, " has been to convey some notion of the contribution of (the last) four generations of British farmers to the problems of their most ancient craft". With masterly compression and acute understanding the authors have been able, in about 300 pages, to describe nearly everything that matters and to link it with the developments of the present day.

To give a few examples : " when Somerville took over (Cockle Park) in the 'nineties the depression had almost reached its nadir . . . he recognized that for the time being only the least expensive improvements were likely to interest the general run of farmers. . . . Cold boulder clay soil and its matted sward was typical of much land that, thirty years earlier had been under the plough. The immediate question . . . was whether with mutton at sevenpence a pound such land could be profitably improved". An affirmative answer was supplied by the use of basic slag.

In 1836 John Boswell was proclaiming that " except a few favoured spots such as banks of rivers, etc., no ground can without loss, be left long in pasture ; that it appears to me four or five years is, generally speaking, the longest period land should be allowed to lie in grass ; that if pasture be the object at the end of that time the ground should be broken up and returned to grass again. I maintain that, without grass, severely cropped land cannot be restored to full fertility ; and without cropping grass cannot be made to continue at the maximum point of verdure and utility." Half a century later Elliot of Clifton Park was announcing that the cheapest and best form of manure is a good turf, not only supplying plant food, but also producing good physical conditions in the soil. With deep-rooting grasses and a proportion of legumes, Elliot thought to dispense with fertilizers altogether failing to realize that the hundreds of lambs sold off "must have carried away in their bones something that could not be replenished from the subsoil". According to the authors, Clifton and Cockle Park were each telling only half the story. Both good plants and a high level of fertility are essential to the making of productive grass.

Finally, Lord Ernle—than whom none more worthily served his day and generation. " During the Napoleonic wars through the immense expenditure of money, much of the land of the country was, for the first time, made, and the great improvements of the eighteenth century enabled the nation, a third of which was then engaged on the land, to endure the hardships of twenty years of almost incessant war." Likewise during the first world war, he reminds us, the fullest possible use of the land enabled the country to stand four years of terrible strain. But he goes on, " although past experience seemed to afford little or no help in the privations which inevitably followed both wars, the same remedy—increased production and economy—had to be sought. Today, as then, there is no other way out. We must create the new earth before we can inherit the new heaven".

I have read this book from cover to cover with the greatest interest, marvelling at the industry and discernment of the authors, envying their terseness and clarity, appreciating their humanity and enjoying their pawky humour. With appropriate parody—

And still they gazed and still the wonder grew
That two small heads could carry all they knew.

Knowing the places and personalities, rather than erudition, has enabled me to detect one or two slips which could be rectified in the next edition : Mungoswalls, Duns—not Mungoswells; Thomas Hudson Middleton—not Hunt Middleton; and Cheddington, Bucks—not Chiddingfold, Surrey—was the situation of Charles Macdonald's farm.

J. G. S.

Commercial Methods of Testing Milk and Milk Products. J. LYONS and M. J. O'SHEA. Cork University Press. 15s.

It is unfortunate that the industrial laboratories attached to the dairy industry in Britain and Ireland have suffered for many years the lack of an authoritative text designed specifically for their use. The aim of such a book would be the collection and concise presentation of all the relevant information needed by a competent scientist in his daily task of injecting an economic quantity of scientific control into the buying, manufacturing and selling activities of a dairy business. It would of necessity cover the physical and bacteriological aspects as well as the chemical, and would be concerned with the interpretation of findings almost as much as with techniques. The book under review does not fill the gap, and probably was not intended to.

The contents of this book may be divided into three parts. In the first two chapters introductory information is given on milk composition and on the nature of milk constituents. The next ten chapters are devoted almost entirely to estimations of butter fat in milk and dairy products, and are prefaced by an interesting chapter devoted to the history of butterfat estimations. Adequate attention is given to calibration of glassware. Other chapters deal with solids-not-fat, detection of adulteration, estimation of acidity, tests for sanitary quality and miscellaneous tests.

The first impression on reading this book is the serious lack of balance between the space devoted to butterfat testing (over half the book) and that dealing with all the other determinations which are regularly made. For example, estimations of butter fat are not widely made in liquid-milk dairies, but phosphatase activity is of great significance. The information given on this subject is neither adequate nor up-to-date. The chapter on sanitary quality is too slight to be of much use, although the chapter on miscellaneous tests and the useful information in the appendix is well worth while.

The text is clearly printed on rather poor paper and the line drawings are adequate, but the few half-tone reproductions are poor.

The book is in no way a complete manual of analytical procedures for the dairy, far less is it an exhaustive treatise on the interpretation of analytical findings. For all that, it is eminently readable, and many students and workers in the industry's laboratories should find within its pages a good deal of useful general knowledge.

H. S. H.

Experimental Designs. W. G. COCHRAN and G. M. COX. Wiley. 46s.

This admirable book had its origins in the numerous requests for statistical advice made to the authors by puzzled experimenters and is an attempt to help those who are not primarily statisticians in using the more advanced techniques. This is not the place to consider the practice of giving a research worker a few lectures in statistics and then expecting him to get the rest out of books. Evidently the authors accept it and have here attempted to provide him with all the further information he can need.

And all the information is indeed provided. The work is most painstaking and thorough, illuminated throughout by a real understanding of the difficulties of the experimenter. Starting with three chapters on the general theory of experimentation, it then devotes ten to a description of particular designs, together with numerous tables to help in the construction and randomization of the actual layout. On each design there are comments that raise the book above the level of a mere catalogue and show the authors' knowledge to be more than theoretical. Finally, there are two chapters, one on the analysis of a series of experiments and the other on random permutations, which surely belong to some other publication, but are very useful. Such a book well deserves a place of handy reference for every statistician.

The only readers for whom one is fearful are those to whom it is addressed. So many get out of their statistical depth on account of an unexamined belief that any complicated technique is better than any simple one, recalling the legendary engineer who declined to build a railway across the prairies because there were no hills to run the tunnels through, for involved designs like tunnels are not used for their own sake but to overcome a special difficulty. A book like this, describing designs of a complexity he had previously never imagined, will be meat and drink to such an experimenter . . . and eventually his S.O.S.'s to the authors will be more numerous and more plaintive. It can hardly be over emphasized that what the ordinary experimenter needs is a good grounding in a few fundamental statistical ideas and some experience with those common straightforward designs that serve so well on 95 per cent of occasions. This excellent book aims at serving on 100 per cent, but it is for the experienced rather than the novice.

S.C.P.

Silage. S. J. WATSON and A. M. SMITH. Crosby Lockwood. 10s. 6d.

Until very recently silage was the Cinderella of conservation processes. The circumstances of the times, however, have transformed Cinderella into a much-sought after princess, and more and more farmers are realizing that this process has an outstanding part to play in solving one of the principal farming problems of the day—the feeding of our livestock with home-grown foods, especially foods rich in protein.

This new book is a welcome addition, therefore, to the literature on the subject, especially when one recalls that Professor Watson was the author of that now unobtainable classic *The Science and Practice of Fodder Conservation.*

The chemical and biological processes through which green forage passes in conversion to silage are succinctly expounded and, indeed, throughout the text the essential science of the subject—and without this knowledge successful silage making is a gamble—is skilfully interwoven with practice. In this way those who assiduously follow this book are assured of successful results.

Suitable crops for ensiling are dealt with in detail and the difficulties attached to ensiling them, particularly those with high water contents, receive special attention. Such by-products as pea and fruit residues, brewers' and distillers' grains, bracken and potatoes, find a place in this chapter. The pros and cons of various types of silo, both temporary and permanent, elaborate and mere expedients, are discussed, as also the varied equipment available for securing the crop.

At a time when a good deal of advice of doubtful value is offered on the contentious question of how to seal a silo, it is reassuring to read "it is always desirable to seal off a silo properly". This, in my experience, is of vital importance if waste is to be reduced to a minimum or eliminated completely. When labour is scarce and expensive, it is perhaps only natural that expedients should be tried to cut down the labour involved in finishing the silo, but any such saving can be more than offset by the loss in silage, some of which may not be readily apparent to the eye.

Finally, the feeding value of silage and its use in rations for all types of stock, is discussed and this chapter merits special commendation. The senior author has made a lifetime study of this complicated aspect of the silage question and the whole substance is explained with admirable lucidity. After reading this section, most farmers should be able to assess the value of their silage with a reasonable degree of accuracy, and then feed it to best advantage.

The final chapter deals with cost of production and here figures are quoted from a variety of sources and for a variety of methods.

The whole essence of the book can be summed up in the authors' own words : "If more farmers realized the worth of silage and the ease with which it can be made, a very great contribution could be made to our National Economy and to our independence of imported feedingstuffs for farm stock." This book clearly points the way. It should be specially useful to advisers and students, and for these readers its value would have been greatly enhanced by the inclusion of full references to the large amount of research work to which reference is made. The book is well illustrated in black and white. A praiseworthy attempt to convey the appearance of good and inferior silage by means of a colour photograph unfortunately fails, due to limitations in the colour process.

H.I.M.

Market Gardening. R. A. ROBINSON. Pearson. 7s. 6d.

A fair amount of useful information is concentrated into this little book of 175 pages. It is divided into two main sections—"The Outfit," and "The Crops". Dealing briefly first of all with the soil, the author goes on to discuss market-garden tools and machinery, and enumerates the equipment in use in different types of holdings and thence to advice on manures, frames and cloches and marketing. A creditable effort is made to leave out as little as possible in dealing with "The Crops" (in 100 pages) and Pests and Diseases and their control (in 8 pages). Unfortunately, there are inaccuracies which may well confuse the beginner. The English light is described as measuring 6 inches × 4 feet, and front boards for Dutch lights as 4 inches × 6 inches. The subject of lime is dealt with in a brief paragraph and soil analysis is mentioned only in connection with the application of minor elements. Mr. Robinson recommends DDT as one of the controls for aphids, and paris green and bran for controlling slugs. Another statement is that "an ounce of tomato seed will produce 2,000 plants".

The faults of this book are that it tries to deal with too much in too little space and that some of the information, particularly that on pest and disease control, is not sufficiently up-to-date.

E.S.

Mere and Moorland (Breath of England Series). NORMAN WYMER. Lutterworth Press. 12s. 6d.

The North of England suggests to many a region of heavy industries, factories, coal mines and all their concomitants, but Mr. Wymer, in his travels, as far south as Nottinghamshire and Derbyshire, as related in *Mere and Moorland*, has made skilful detours from the heavily populated areas. He does not entirely ignore industry. He gives us in some detail an account of the processes of manufacture of such diverse commodities as china, tobacco, salt, soap and cheese, but it is the craftmanship inherent in the manufacture of these articles that appeals to him.

Every old building has its history. Those in the North are steeped in legend and folklore. The inquiring mind of the author has probed into these, and the amount of information he has given us is almost encyclopaedic. I think this book should be read like an encyclopaedia, a little at a time, if one is to derive the fullest value from it.

The illustrations are very good and apt. Mr. Wymer has used his camera well.

Sport is not overlooked. The prominence of Yorkshire in this sphere has been admitted. And this is only right. Yorkshire is a challenge to any county in any sport.

Agriculture is not dealt with other than by fleeting references, yet this book will be of great interest to all countrymen, as nearly every art and craft ancillary to agriculture receives attention.

I put the book down when I had finished reading it, very conscious of the fact that there are many places in the North that I have been meaning to explore for a long time, and full of resolve that these visits should not be long delayed.

C. H. W.

Scientific Horticulture (Vol. 10) 1950–51. Horticultural Education Association. 10s. 6d.

Professional horticulturists in many fields look forward to the all too rare appearance of a new issue of *Scientific Horticulture*, the official Journal of the Horticultural Education Association. As such, it serves as a vehicle of publication for many of the useful papers read at the Association's meetings and conferences. One result of the Journal's infrequent appearance is that each issue tends to get larger and its contents more varied.

The issue under review contains no less than twenty-three signed contributions and runs to 240 pages including 18 pages of half-tone illustrations. Here is a rich miscellany of reading for winter evenings, providing both entertainment and education ; for example, J. P. Hudson's account of horticulture in New Zealand is every bit as entertaining as a travel lecture. Entertaining, too, are the pleasantly worded and discursive accounts of market gardening in the Lothians given by those well-known and experienced practitioners—R. L. Scarlett, W. C. Ritchie and D. Lowe.

However, the " old hands " of the horticultural world, who eagerly scan contents pages for " something new," will not be disappointed, for the list of contributions contains several papers of real value. I liked, perhaps best of all, Professor S. J. Wellensiek's account of horticulture and horticultural research in Holland. In a country which for many years has relied substantially for its prosperity on a highly developed horticulture and agriculture, there are, we learn, no less than sixty-six horticultural schools and thirty-five Government horticultural advisers, with over 250 assistants. From the brief references the Professor makes to various branches of scientific research one gleans several items of information ; e.g., the story of how the Dutch scientists found a way to control *Fusarium* disease of cucumbers by grafting the plants on a resistant rootstock derived from a wild species of *Cucurbita*.

This issue of *Scientific Horticulture* contains two sets of papers which have considerable practical value. The first consists of two "omnibus" accounts of plant propagation methods at the Royal Botanic Gardens, Kew, and at the Royal Horticultural Society's Gardens, Wisley. Each account was prepared by O. W. Shill and is based on reports made of practical demonstrations given at each centre for Conferences of the Association held in 1949 (Kew) and 1950 (Wisley). The other set consists of three separate papers by well-known soil specialists—B. S. Furneaux, D. A. Osmond and E. Crompton. These papers are not only well written and informative but possess real distinction ; I found each in its own way extremely interesting, besides forming a useful contribution to our knowledge of Britain's soils.

Amongst the remainder of the contributions are three accounts of work at research stations. R. B. Dawson writes of twenty-one years' work of the St. Ives Turf Research Station ; E. R. Hoare gives a short account of the National Institute of Agricultural

Engineering, Silsoe, and the horticultural problems being tackled there ; and R. L. Edwards gives an account of the work of the Mushroom Research Association at the Yaxley Research Station. Mention should be made of an article contributed by L. P. Smith, entitled *Meteorology and Horticulture*, that appears helpfully at a time when the significance of weather as an important factor affecting horticultural production is more fully appreciated than it has ever been.

The editor's task of preparing such a miscellaneous collection is certainly an onerous one, and on the whole is ably discharged.

A. H. H.

The Smallholder Encyclopaedia. Edited by S. A. MAYCOCK and JOHN HAYHURST. Pearson. 25s.

A successful encyclopaedia—and that phrase does not necessarily imply a financial success—is no easy work to prepare. To be of the greatest use to those for whom it is intended, an encyclopaedia should cover adequately the more important subjects, while including brief notes on the less important ones, and in very many instances giving merely definitions of phrases and terms that are apt to differ between area and area. The handsome volume under notice goes far to fulfil the requirements, and the Editors are to be congratulated on having been able to do far better than the previous (war-time) edition of 1943. Owing to the war, that edition was produced without illustrations, which can so well help the text if wisely employed for that purpose, rather than for mere ornament—though often they may be both useful and a pleasure to the eye. Very many illustrations have again been included by the Editors, and on good paper are generally excellent.

It may nevertheless be suggested that smallholdings are accepted in the main as holdings of from one to fifty acres, and the average reader is almost bound to feel that 52 pages devoted to dogs and 165 pages to poultry are out of all proportion large, when compared with only 86 pages for farm stock (cattle, sheep and horses) and crops—a section that might be expected to occupy chief place. Further, pig-keeping alone occupies 69 pages. Poultry-keeping is certainly important, but does it deserve in an encyclopaedia for smallholders twice the attention given to farm stock and crops ? Dog breeding also does not fall within the definition of a smallholding as given on p. 566—" a holding used or intended to be used for agriculture". A short section about farm dogs might be legitimate, but on the scale devoted to all sorts of dogs it might be equally reasonable to include cage birds !

The hope may be expressed that the Editors will " think again " when preparing the next edition, which will surely be required. It is not intended to be hypercritical of a volume that is certain to have an extensive sale, but there is the insistent feeling that the available space has been injudiciously allotted.

The Smallholder Encyclopaedia was originally prepared many years ago by the late Mr. Walter Brett when Editor of " The Smallholder", and a " new and revised edition " was issued in 1943. I am tempted to ask, therefore, why the current edition should be described as " First published 1950 " ?

H.C.L.

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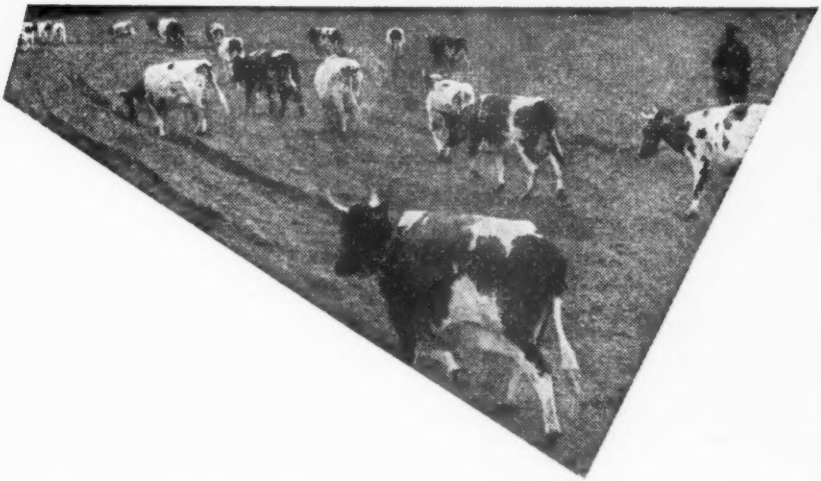

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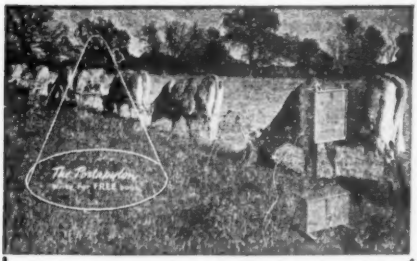

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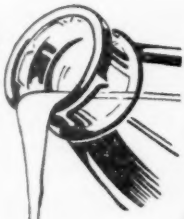

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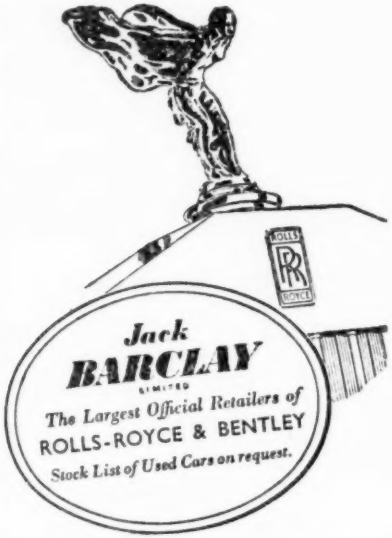

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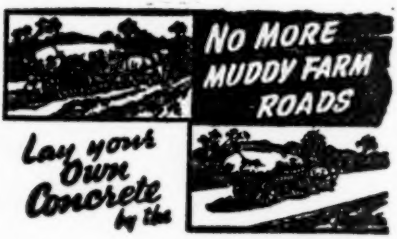

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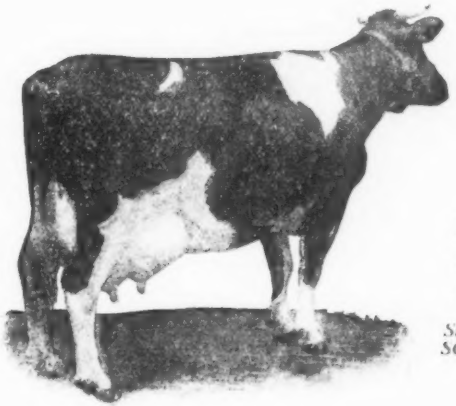

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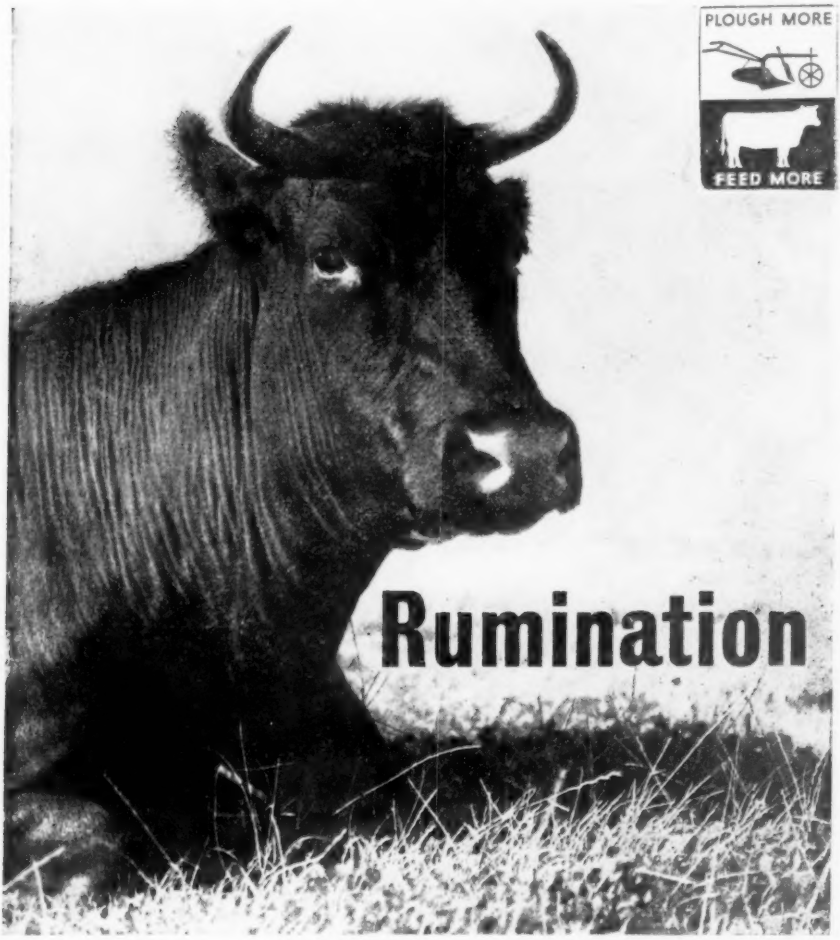

Farmers are fortunate in that their occupation gives them time to think quietly.

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